User's
Manual

EXA OXY

Model ZS8
Flameproof
Zirconia Oxygen Analyzer

IM 11M7A3-01E

vigilantplant.®

YOKOGAWA
Yokogawa Electric Corporation

IM 11M7A3-01E
4th Edition

PREFACE

This instruction manual describes the handling of the flameproof zirconia oxygen analyzer.
To ensure safe operation and maximum performance of flameproof zirconia oxygen analyzer, read this manual carefully before using it.

Items to which attention needs to be paid with regard to the handling of the flameproof zirconia oxygen analyzer, are shown in this manual in the form of WARNING and CAUTION. These items must be read before it is put in operation.

WARNING

Items involving serious accidents due to incorrect handling of flameproof zirconia oxygen analyzer.

CAUTION

Items involving injury, damage to device or physical damage.

WARNING

- Power source
  Before the power for the unit is turned ON, make sure that the power voltage conforms to the power supply voltage.
- Earthing
  Before turning ON the power for the unit, be sure to earth the unit to prevent electric shocks.
- Necessity of earthing
  Neither cut off the internal (or external) earth cable of the unit, nor disconnect the earth terminal, otherwise, it causes a hazard to human body.
- Defect in function
  If protective functions such as earthing, fuse, etc. seem to be defective, do not operate the unit. Before operating the unit, check to make sure that the protective functions are not defective.
- Fuse
  To prevent fire accidents, be sure to use the specified type of fuse. Do not attempt to use other types of fuses. Care should be taken not to short the fuse holder.
  When it becomes necessary to replace fuse, turn OFF the power switch and disconnect the unit from the main power source.
- Do not touch the inside.
  The unit has high-voltage circuits. Do not touch the inside of the unit when the power is ON. Do not replace or repair the unit by yourself. Contact our service-man or authorized engineer.
- External connection
  The unit must be earthed before connecting it to measuring object or external control circuit.
- Prohibition of modification or mounting of additional parts in unit
  Do not attempt to modify or mount additional parts in the unit, otherwise, it affects the safe operation or damages the unit.

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WARNING

- Before opening the cover of the ZS8C converter, remove power and make sure of non-hazardous (*) atmospheres.
- When the ambient temperature of the converter exceeds 50ºC, use wire resistant to 70ºC or greater for external wiring.

(*) The text plate says "Open circuit at non-hazardous location before removing cover," since the internal energy of the ZS8C converter decreases under the specified value.
The definition of the non-hazardous area is followed by the description in the Users Guide to Installing Flameproof Electrical Apparatus at Plants, issued by the Technology Institution of Industrial Safety, Japan: As a non-hazardous area is considered a place where no occurrence of explosive gas atmospheres is guaranteed by the foreperson and confirmed by a written document. Therefore, if non-hazardous area is secured, it is allowed to open the cover in the field.

- Before opening the cover of the ZS8D detector, remove power and allow the detector to stand at least 40 minutes.
- When the ambient temperature of the detector exceeds 30ºC, use wire resistant to 70ºC or greater for external wiring.
- The detector cannot be used except in mixed gases composing air or mixed gas with oxygen concentration lower than air, or combustible gas or vapor.

CAUTION

- Choose a suitable location for installation.
  The unit should be installed in a place of normal temperature and humidity where there is less change in temperature and the unit is not exposes to strong radian heat and direct sunlight. Since the unit is designed for indoor use, choose a place free from direct wind/rain or use a suitable case cover.
- Do not use the unit in a place with vibration.
- Cleaning of instrument
  Do not use benzine or thinner for cleaning, as it deforms or cracks the unit.
- Use in good atmosphere
  The unit should be used in a clean place free from corrosive or combustible gas.
- Caution to electric shocks
  The earth cable must be earthed to prevent electric shocks.
- Key operation
  Do not operate the keys on the front of the instrument with a sharp-end object.

◆ Introduction

The EXA OXY Model ZS8 Flameproof Oxygen Analyzer is used for combustion status monitoring or control in processes which require combustion control in every field. There are several types of EXA OXY detectors, and the auxiliary equipment needed for optimum measurement are also available. Also, devices for automating calibration are available. As stated above, since many kinds of equipment and devices are available for this EXA OXY analyzer, select the appropriate devices and construct the optimum measuring system when this model is to be used.

This manual describes the installation, operation, inspection and maintenance of almost all of the equipment related to EXA OXY systems. Read the instructions thoroughly before you handle the equipment but you may skip sections on equipment which is not included in your system.

The types of equipment described in this manual and the contents for each one are as shown below.

Types of Equipment Described in This Manual and Contents for Each One

Model	Product Name	Items Described in the Manual				
		Specifi-cations	Instal-lation	Opera-tion	Mainte-nance	CMPL
ZS8D-L	General-purpose detector	○	○	○	○	○
ZS8D-H	High-temperature detector	○	○	○	○	○
ZS8C	Converter	○	○	○	○	○
ZS8P-H	Probe adaptor	○	○			○
ZA8F	Flow setting unit	○	○	○		
—	Ejector assembly (Part No.: K9292VA/VB/WA/WB)	○	○			○
—	Calibration gas unit case (Part No.: E7044KF)	○	○			

CAUTION

There are two types of general-purpose detectors: one which vents to the outside of a furnace the mixed gases of a sample gas suctioned in by the ejector and ejector air, and another which returns mixed gases to the furnace. High-temperature detectors all vent to the outside of a furnace. Vent the mixed gas of a sample gas and ejector air to a place where no safety problems will occur (the venting flowrate should be 40 to 50 l/min). A general-purpose detectors may be a “return to the furnace” type. A return pipe is provided as standard. However, be cautious in returning gas to a furnace because air is blown into the furnace. The normal flow rate of Netwrining gas is approximately 3 l/min to 5 l/min.

This manual takes the following configuration. A brief description of each chapter and the chapters to be referred to for installation, operation and maintenance are given.

Chapter configuration of the manual and items to be referred to.

Chapter Configuration of This Manual and Items to be Referred to

Chapter	Brief description	For reference to		
		Instal-lation	Opera-tion	Mainte-nance
1. General	System component units for the EXA OXY zirconia oxygen analyzer and system configuration are shown.	◎	△	○
2. Installation	Installation procedures for each unit are described.	◎		△
3. Piping	Piping procedures are explained for four standard system configurations.	◎		△
4. Wiring	Wiring procedures are given for each system, such as power supply wiring, output signal wiring, etc.	◎		△
5. Components and their functions	Names and major functions of components of main units in the manual are illustrated.	△	◎	◎
6. Operation	Basic procedures are presented to put the EXA OXY analyzer into the operation status.		◎	△
7. Operating keys and display of converter	Converter key operations and items related to the display are detailed.		◎	△
8. Calibration	Calibration procedures carried out as necessary are described.		◎	△
9. Inspection and maintenance	Inspection items to maintain the EXA OXY analyzer performance and procedures for replacing deteriorated parts and components are described.		○	◎
10. Troubleshooting	Countermeasures when the system fails and/or disposition for failure are shown.		△	◎
Customer maintenance parts list	Parts that can be freely replaced by the user if damaged are illustrated for each unit.		△	○

◎ : Thoroughly read the instructions and do work after fully understanding the contents.
○ : Before actual work, first read the description or refer to it if necessary.
△ : It is recommended that you read the description.

◆ Precautions for Flameproof Instruments

1. General

Instruments with Flameproof construction (hereafter referred to as flameproof instruments) are tested and certified by the public authority in accordance with the Labor Safety and Health Laws of Japan.

A certified instrument is provided with a certification label and a nameplate that states specifications required for explosion protection performance. All installations of certified instruments should be executed in compliance with the nameplate specifications.

For details, see USERS' GUIDELINES for Electrical Installation for Explosive Gas Atmospheres in General Industry, issued by the Research Institute of Industrial Safety of the Ministry of Labor in Japan, 1994.

2. Flameproof Instruments

Instruments that can be termed "flameproof" must satisfy the following conditions.

They must have been tested and certified by an official body in accordance with the Industrial Safety and Health Act and must carry a certification label on them.

They must be used in accordance with the specifications stated on the nameplate.

The following operating conditions must be observed.

(1) ZS8D Detector

(a) Before opening the cover, remove power and allow the detector to stand at least 40 minutes.

(b) When the ambient temperature of the detector exceeds 30ºC, use wire resistant to 70ºC or greater for external wiring.

(c) The detector cannot be used except in mixed gases composing air or mixed gas with oxygen concentration lower than air, or combustible gas or vapor.

(2) Converter

(a) Before opening the cover, remove power and make sure of non-hazardous atmospheres. The warning added on page i must be observed.

(b) When the ambient temperature of the converter exceeds 50ºC, use wire resistant to 70ºC or greater for external wiring.

3. Flameproof Instrument Installation

(1) Installation Area

Flameproof instruments may be installed in hazardous areas where the specified gases are present. They should not be installed in Division 0 areas.

Note: Hazardous areas are distinguished based on the frequency and duration of the occasions when explosive atmospheres are encountered (IEC standard 79-10 classification of hazardous areas).
Areas where explosive atmospheres are continuously present or persist for long periods are classified as Division 0.
Areas where there is a risk that an explosive atmosphere will be encountered during normal operation of the equipment and facilities are classified as Division 1.
Areas where there is no risk that an explosive atmosphere will be encountered during normal operation of the equipment and facilities, and where an explosive atmosphere will persist for only a short period even if encountered, are classified as Division 2.

(2) Environmental Conditions

The standard environmental condition for flameproof instrument installation is an ambient temperature range of −20 to 40°C. If the equipment is installed where there is a risk that it may be exposed to radiant heat from plant equipment, direct sunlight, etc., take steps to heat-insulate the equipment.

4. External Wiring for Flameproof Instruments

External wiring for flameproof instruments must employ cable wiring. Securely ground all non-live metal parts. For details, see USERS' GUIDELINES for Electrical Installation for Explosive Gas Atmospheres in General Industry, issued by the Research Institute of Industrial Safety of the Ministry of Labor in Japan, 1994.

It is recommended to use cable glands for wiring.

- Use PVC insulated and sheathed control cable CVV (JIS C 3401) or equivalent. Where protection from external physical damage is required, the cable must be enclosed in steel conduit.
- Connections between such cables, or between such cables and wiring routed through flameproof metal conduit, must be enclosed in a flameproof junction box per item (2), to prevent any explosive gases from entering and flame fronts from moving in cables.
- For instruments in which cables are to be brought in through flameproof packings, use the flameproof packing glands specified for use with the instruments and select the flameproof packings whose internal diameters are appropriate for the cable external diameters.
- If a flameproof packing gland is used, screw it into the connection port so that a minimum of five threads are fully engaged, and fasten securely with a lock nut. It is mandatory that a nonhardening sealant be applied to the threads for waterproofing.
- The flameproof gland packing should be securely tightened to prevent the passage of explosive gases or flame fronts.

5. Maintenance of Flameproof Instruments

When opening the cover for maintenance, the warning added on page i must be observed.

(1) Maintenance with Power ON

Maintenance of flameproof instruments with power on should be avoided unless there is no alternative. However, if maintenance with power on cannot be avoided, a gas detector should first be used to verify that an explosive atmosphere is not present, before the instrument cover is opened. If it is not possible to verify that explosive gases are not present, the scope of maintenance should be limited to the following:

(a) Visual inspection
Visually inspect the flameproof instrument, metal conduit, cables, etc., for physical damage and corrosion, and other mechanical and structural defects.

(b) Key operation
Adjustment should be made only to the extent that it can be done from the outside without opening the instrument cover. Great care must be taken not to cause mechanical sparks with tools.

(2) Repairs

If a flameproof instrument requires repair, turn off the power, and carry the instrument to a nonhazardous area. Observe the following points during repair:

(a) Make only such electrical and mechanical repairs as will restore the equipment to its original condition. In the case of a Flameproof instrument, mechanical aspects such as the gaps and path lengths of joints and mating surfaces, and mechanical strength of enclosures, are critical factors in explosion protection. Exercise great care not to damage the joints and mating surfaces, and to protect enclosures from shock.

(b) If damage is incurred by any area of a part critical to the maintenance of flameproof performance (for example, threads, joints or mating surfaces, inspection windows, connecting section between transmitter and terminal box, shrouds or clamps, external wiring connection ports, etc.), contact Yokogawa.

Note: Never rethread a threaded connection or refinish or touch up the finish on a joint or mating surface. Doing so is extremely dangerous, as the flameproof explosion protection will be compromised.

(c) Unless otherwise specified, electrical circuits and mechanisms inside the enclosure may be repaired by component replacement, as this will not directly affect flameproof explosion protection (however, the instrument should always be restored to its original condition). Only Yokogawa-specified parts should be used for repair.

(d) Before returning a repaired instrument to service, always reinspect all parts necessary for the preservation of flameproof explosion protection. Verify that all screws, bolts, nuts, and threaded connections are properly tightened.

(3) Prohibition of Specification Changes and Modifications

Users are prohibited from making any modifications to specifications or physical configuration, such as adding or changing the configuration of external wiring ports.

6. Flameproof Packing Gland Selection

CAUTION

The flameproof packing glands used at the external wiring connection ports of Flameproof instruments conforming to IEC standards are certified in combination with the flameproof instruments. Therefore, only those flameproof packing glands specified by Yokogawa should be used.

◆ After-Sales Warranty

- **Do not modify the product.**

- **Yokogawa warrants the product for the period stated in the pre-purchase quotation. Yokogawa shall conduct defined warranty service based on its standard. When the customer site is located outside of the service area, a fee for dispatching the maintenance engineer will be charged to the customer.**

- **During the warranty period, for repair under warranty carry or send the product to the local sales representative or service office. Yokogawa will replace or repair any damaged parts and return the product to you.**
  - Before returning a product for repair under warranty, provide us with the model name and serial number and a description of the problem. Any diagrams or data explaining the problem would also be appreciated.
  - If we replace the product with a new one, we won't provide you with a repair report.

- **In the following cases, customer will be charged repair fee regardless of warranty period.**
  - Failure of components which are out of scope of warranty stated in instruction manual.
  - Failure of components which are out of scope of warranty stated in instruction manual.
  - Failure caused by usage of software, hardware or auxiliary equipment, which Yokogawa did not supply.
  - Failure due to improper or insufficient maintenance by user.
  - Failure due to misoperation, misuse or modification which Yokogawa does not authorize.
  - Failure due to power supply (voltage, frequency) being outside specifications or abnormal.
  - Failure caused by any usage out of scope of recommended usage.
  - Any damage from fire, earthquake, a storm and flood, lightning, disturbance, riot, warfare, radiation, and other natural changes.

- **Yokogawa does not warrant conformance with the specific application at the user site. Yokogawa will not bear direct/indirect responsibility for damage due to a specific application.**

- **Yokogawa will not bear responsibility when the user configures the product into systems or resells the product.**

- **Maintenance service and supplying repair parts will be covered for five years after the production ends. For repair this product, please contact the nearest sales office described in this instruction manual.**

Model ZS8
Flameproof
Zirconia Oxygen Analyzer

IM 11M7A3-01E 3rd Edition

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Revision Record i

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1. General

The ZS8 flameproof zirconia oxygen analyzer can be used for monitoring and controlling oxygen concentrations in combustion gases in heating furnaces or boilers in petroleum refining, petrochemical and city gas production industries.
The analyzer mainly consists of a detector and a converter. The ZS8 flameproof detector includes general-purpose detectors that can be used for measuring gases at up to 800°C and high-temperature detectors that can be applied to measuring gases at 800°C or more. These detectors are both direct-insertion detector. This allows the detectors to be mounted on flue walls or the like to measure internal gases directly. The converter has good operability and is provided with many functions (measurement and computing functions and maintenance functions such as self-diagnosis) as standard. In addition, digital communication functions can be added. For calibration, one-touch calibration can be performed with key operation of the converter by using the ZA8F flow setting unit and making zero and span gases flow. As stated above, since the ZS8 flameproof zirconia oxygen analyzer is provided with a number of functions and many auxiliary units, the optimum system can be constructed by selecting the units matching an application.

1.1 System Configuration

The ZS8 oxygen analyzer is composed of the following units:

(1) ZS8D flameproof detector

(2) ZS8C flameproof converter

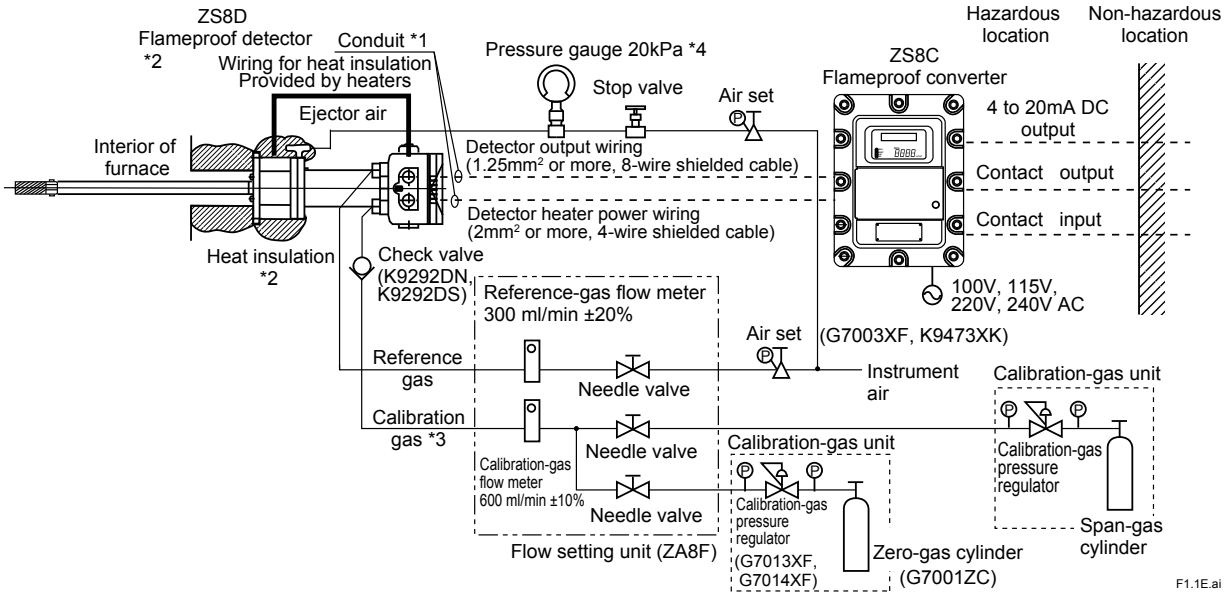
(3) ZA8F flow setting unit

(4) Calibration gas unit (consists of a zero-gas cylinder, pressure regulator, and case assembly).

However, note that the units to be used differ depending on the specifications.

1.1.1 Examples of System Configuration

(1) Example of Heat Insulation with Electric Heater (for the ZS8D-L flameproof detector)



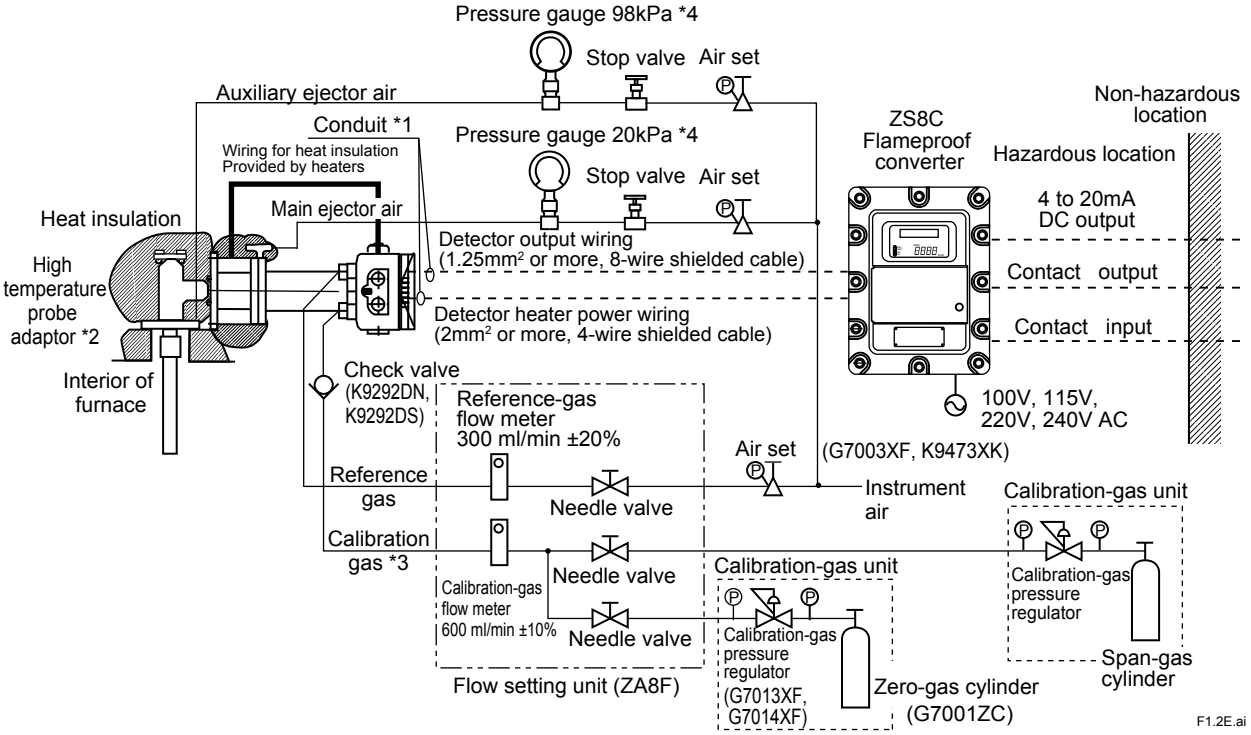
*1: Conduits
1) When installing conduits, use flexible conduits so that the probe removed.
2) Use a shielded cable for the signal cable and ground the shield together with the probe ground.
3) Provide separate conduits for the signal and heater lines.
4) The maximum outside diameter of the cable suited for the cable gland used for the instrument is 13.5mm (in case that the thread at the conduit side is G3/4)

*2: The probe material SUS310S or SiC should be selected according to the specified measurement gas temperature (SUS310S: 0 to 800°C, SiC: 800 to 1400°C).

*3: For the zirconia oxygen analyzer, 100% nitrogen cannot be used as the zero gas. Generally, approximately a 1 vol% oxygen (nitrogen gas balance) mixture is used.

*4: The setting of the ejector supply air pressure depends on the furnace pressure.

(2) Example of Heat Insulation with Electric Heater (for the ZS8D-H flameproof high-temperature detector)



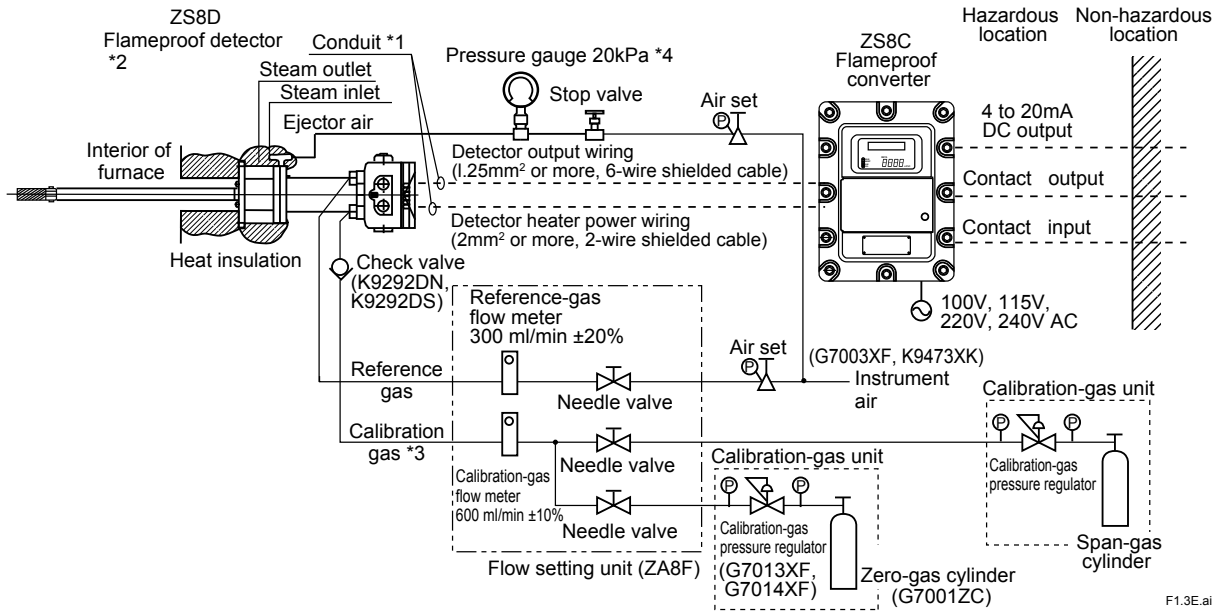
*1: Conduits
1) When installing conduits, use flexible conduits so that the probe removed.
2) Use a shielded cable for the signal cable and ground the shield together with the probe ground.
3) Provide separate conduits for the signal and heater lines.
4) The maximum outside diameter of the cable suited for the cable gland used for the instrument is 13.5mm (in case that the thread at the conduit side is G3/4)

*2: The probe material SUS310S or SiC should be selected according to the specified measurement gas temperature (SUS310S: 0 to 800°C, SiC: 800 to 1400°C).

*3: For the zirconia oxygen analyzer, 100% nitrogen cannot be used as the zero gas. Generally, approximately a 1 vol% oxygen (nitrogen gas balance) mixture is used.

*4: The setting of the ejector supply air pressure depends on the furnace pressure.

(3) Example of Steam Trace Heat Insulation (for the ZS8D-L flameproof detector)



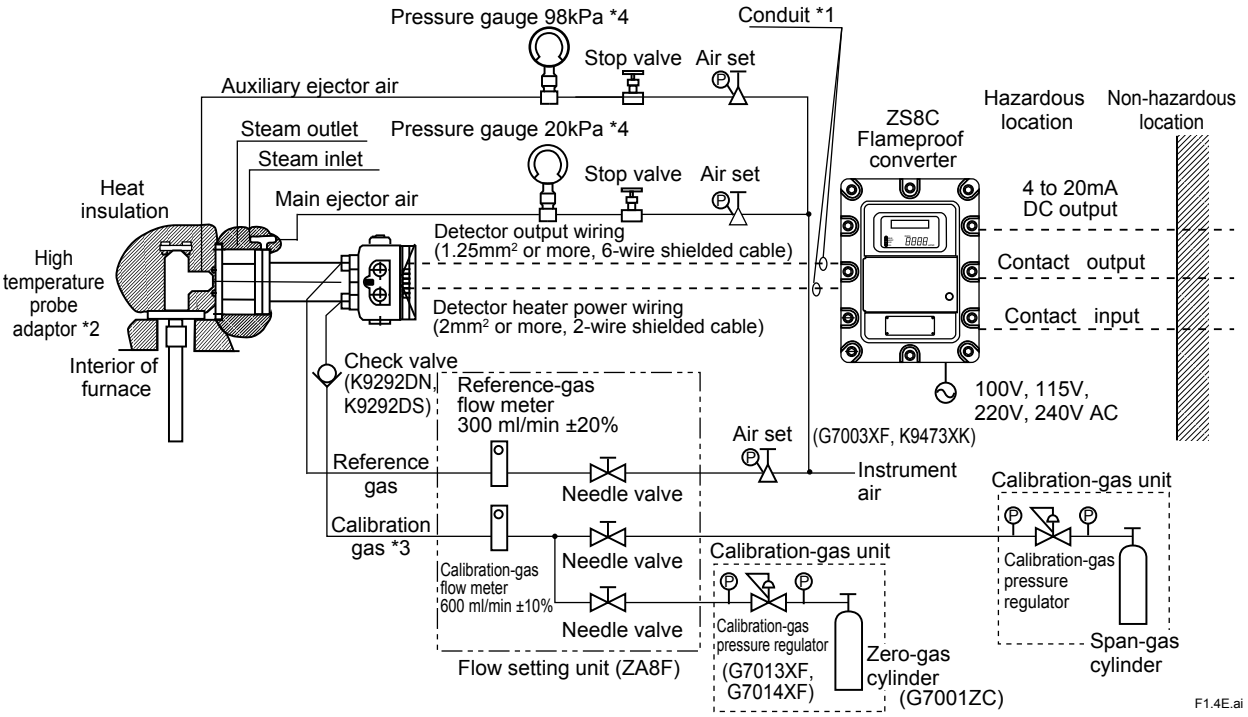
*1: Conduits
1) When installing conduits, use flexible conduits so that the probe removed.
2) Use a shielded cable for the signal cable and ground the shield together with the probe ground.
3) Provide separate conduits for the signal and heater lines.
4) The maximum outside diameter of the cable suited for the cable gland used for the instrument is 13.5mm (in case that the thread at the conduit side is G3/4)

*2: The probe material SUS310S or SiC should be selected according to the specified measurement gas temperature (SUS310S: 0 to 800°C, SiC: 800 to 1400°C).
Detectors need sufficient heat insulation. For combustion including ion components, ensure heat insulation greater than dew point of sulfuric acid (about 160°C). In this case, the steam pressure should be greater than 800kPa. If such pressure cannot be obtained, use heat insulation with an electric heater.
For gas combustion where ion components are not included, heat insulation at about 130°C is sufficient even at a steam pressure of 200 to 300kPa.

*3: For the zirconia oxygen analyzer, 100% nitrogen cannot be used as the zero gas. Generally, approximately a 1 vol% oxygen (nitrogen gas balance) mixture is used.

*4: The setting of the ejector supply air pressure depends on the furnace pressure.

(4) Example of Steam Trace Heat Insulation (for the ZS8D-H flameproof detector)



*1: Conduits
1) When installing conduits, use flexible conduits so that the probe removed.
2) Use a shielded cable for the signal cable and ground the shield together with the probe ground.
3) Provide separate conduits for the signal and heater lines.
4) The maximum outside diameter of the cable suited for the cable gland used for the instrument is 13.5mm (in case that the thread at the conduit side is G3/4)

*2: The probe material SUS310S or SiC should be selected according to the specified measurement gas temperature (SUS310S: 0 to 800°C, SiC: 800 to 1400°C).
Detectors need sufficient heat insulation. For combustion including ion components, ensure heat insulation greater than dew point of sulfuric acid (about 160°C). In this case, the steam pressure should be greater than 800kPa. If such pressure cannot be obtained, use heat insulation with an electric heater.
For gas combustion where ion components are not included, heat insulation at about 130°C is sufficient even at a steam pressure of 200 to 300kPa.

*3: For the zirconia oxygen analyzer, 100% nitrogen cannot be used as the zero gas. Generally, approximately a 1 vol% oxygen (nitrogen gas balance) mixture is used.

*4: The setting of the ejector supply air pressure depends on the furnace pressure.

1.2 Specifications

1.2.1 General Specifications

Measurement Target:

Oxygen concentration in combustion exhaust gases and mixed gases
(excluding flammable gases)

Measurement System:

Zirconia system

Flameproof Construction:

Detector; Exd II BT3X (Max. surface temperature of 200°C)
Converter; Exd II BT6 (Max. surface temperature of 85°C)

Used condition of Flameproof

Converter:

(a) Before opening the cover, remove power and make sure of non-hazardous atmospheres.

(b) When the ambient temperature of the converter exceeds 50°C, use wire resistant to 70°C or greater for external wiring.

Detector:

(a) Before opening the cover, remove power and allow the detector to stand at least 40 minutes.

(b) When the ambient temperature of the detector exceeds 30°C, use wire resistant to 70°C or greater for external wiring.

(c) The detector cannot be used except in mixed gases composing air or mixed gas with oxygen concentration lower than air, or combustible gas or vapor.

Measurement Range:

Display; 0 to 100 vol%O_2 (3-digit digital display)
Output; 0 to 5 vol%O_2 to 0 to 25 vol%O_2
Although the measuring range can be set up to 0 to 25 vol%O_2, a sample gas with the oxygen concentration of over 21 vol%O_2 cannot be measured in terms of the flameproof standard.

Warm-up Time:

Approx. 30 minutes

Maximum Distance Between Probe and Converter:

Conductor two-way resistance must be 10Ω or less
(300 m or less with 1.25 mm^2 conductors)

Power Supply:

100, 115, 220, 240 V AC +10%, −15% 50/60 Hz

Power Consumption:

Analyzer; 80 VA for ordinary use, maximum of 270 VA
Electric heaters providing heat insulation;
approximately 200 VA for ordinary use, maximum of approximately 400 VA

1.2.2 Characteristics

Repeatability: ± 0.5% of span (0 to 5 vol%O_2 or more and up to 0 to 25 vol%O_2 range)

Linearity: ± 1% of span(0 to 5 vol%O_2 or more and up to 0 to 25 vol%O_2 range)

[Sample gas pressure: within + 4.9 kPa]
The following conditions must be satisfied.
Use oxygen of known concentration (with in the measuring range) as the zero and span calibration gases.
Excluding standard gas tolerance
Excluding the cases where the reference air is by natural convection.

Drift: ± 2.0% of span/month (both zero and span)

Response Time: 90% response within 5 seconds (measured when gas is fed through the calibration gas inlet and the analog output signal begins to change)

1.2.3 Flameproof Detector ZS8D

(1) Specifications

Sampling Method: Air ejector method

Ejector air; Supply pressure 20 kPa, flow rate at 4 l/min or less
At atmospheric pressures inside the furnace
(As sample-gas exhaust methods, “recirculate in furnace” and “discharge outside furnace” are available. Specify the method using our model code according to specifications when ordered.
For high-temperature detector, only “discharge outside furnace” is available.)

Sample Gas Temperature:

ZS8D-L; 0 to 800°C (general-purpose detector)

(Probe material: SUS310S)

ZS8D-H; 800 to 1400°C (high-temperature detector)

(Probe material: SiC)

For this type, probe adaptor ZS8P-H is required. (The ZS8D-H high-temperature detector can be selected if a general-purpose detector cannot be installed owing to limited installation space.)

Sample Gas Pressure: −5 to 5 kPa for the ZS8D-L general-purpose detector

−1.5 to 5 kPa for the ZS8D-H high-temperature detector

Gas Flow Velocity: 30 m/s or less

Dust Amount: 500 mg/Nm^3 or less

Heat Insulation: (Select either heat insulation provided by electric heaters or by steam.)

Heat insulation provided by steam

Pressure: Normal 800 kPa, maximum 1 MPa
At temperatures above the dew point of sulfuric acid (below 160°C) and for gas combustion, there are no sulfuric components, so heat insulation can be attained at a steam pressure of 200 to 300 kPa. Specify when heavy oil or heavy oil and gas fuel is used.

Heat insulation provided by electric heaters

Specify only when gas fuel is used.

Power consumption; 200 VA for ordinary use,
maximum of 400 VA;
Temperature: 130°C (Gas fuel)

Reference Gas: Instrument air 300 ml/min ± 20%

Calibration Gas: Instrument air and standard gas 600 ml/min ± 10%.

Insertion Length: 0.5, 0.7, 1.0, 1.5 m

Surface Temperature: 200°C or less

Material in Contact with Gas:

Probe SUS310S (or SUS304), Zirconia, SUS304 (flange), SUS316 (tube)

Installation: Flange mounting

Probe mounting angle

- ZS8D-L; For SUS310S, between the horizontal and vertically down positions
- ZS8D-H; For SUS310S, between the horizontal and vertically down positions
  For SiC: Vertically down (within ± 5°)

Joint; Rc1/4 or 1/4NPT (F)

Flange:
- ZS8D-L; JIS 10K-100-FF SUS304, JPI Class 150-4-RF SUS304, ANSI Class 150-4-RF (no serration) SUS304, DIN PN10-DN100-A SUS304.
- ZS8D-H; JIS 5K-65-FF SUS304

Case Material: Material in contact with gas; SUS316
Terminal box; Aluminum
Others; SUS304

Weight: Approx. 10.3 kg with an insertion length of 0.15 m (JIS high-temperature use).

Approx. 13 to 15 kg with an insertion length of 0.5 m (for JIS/JPI/ANSI/DIN applications).

Approx. 12 to 15 kg with an insertion length of 0.7 m (for JIS/JPI/ANSI/DLN applications).

Approx. 14 to 16 kg with an insertion length of 1 m (for JIS/JPI/ANSI/DIN applications).

Approx. 15 to 17 kg with an insertion length of 1.5 m (for JIS/JPI/ANSI/DIN applications).

(2) Model and Suffix Codes

Model	Suffix code	Option code	Description
ZS8D	-L	·····	General-purpose detector (0 to 800°C)
	-H	·····	High-temperature detector (800 to 1400°C)
Flameproof standard	-J	·····	Exd II BT3X (Maximum surface temperature: 200°C)
Probe material	-A	·····	SUS310S: Specify for general-purpose detector.
	-L	·····	SUS304: Specify for high-temperature detector.
Insertion length	-010	·····	0.1 m: Specify for high-temperature detector.
	-050	·····	0.5 m: SUS310S (0 to 800°C)
	-070	·····	0.7 m: SUS310S (0 to 800°C)
	-100	·····	1.0 m: SUS310S (0 to 800°C)
	-150	·····	1.5 m: SUS310S (0 to 800°C)
Heat insulation model	-1	·····	Steam heater (*1)
	-2	·····	Electric heater (*1)
Power supply (electric heater providing heat insulation)	-N	·····	For heat insulation provided by steam heaters
	-3	·····	220V AC, 50/60Hz
	-4	·····	240V AC, 50/60Hz
	-5	·····	100V AC, 50/60Hz
	-8	·····	115V AC, 50/60Hz
Exhaust method (*2)	-N	·····	Specify for high-temperature detector.
	-0	·····	Discharge outside furnace
	-1	·····	Recirculate in furnace
Flange joint connection	-H	·····	JIS 5K-65-FF, specify for high-temperature detector.
	-J	·····	JIS 10K-100-FF
	-K	·····	JPI Class 150-4-RF
	-A	·····	ANSI Class 150-4-RF
	-E	·····	DIN PN10-DN100-A
Calibration gas, reference gas, and ejector inlet joints (*3)	J	·····	Rc1/4
	A	·····	1/4NPT (F)
Heat insulation jacket (*4)		/JS	For steam heaters
		/JE	For electric heaters

(*1) A steam heater [-1] must be specified when heavy oil fuel gas and heavy oil fuel mixture is used or clew point temperature of exhaust gas is about 130°C. By selecting either -1 or -2, the steam heater or electric heater is installed. For high-temperature detector, only "discharge outside furnace" is applied.
(*2) Select whether to discharge mixed gases (the sample gas sucked in by the ejector plus the ejector air) outside the furnace or to recirculate them in the furnace. If -1 is selected, a gas-return pipe is provided.
(*3) The flameproof detector is equipped with a check valve and auxiliary ejector assembly as standard.
(*4) Heat insulation jacket must be ordered. It is essential to use owning hood in where installed in surrounding rain.

(Notes)

(1) Always use the specified external cable lead-in apparatuses given in the table below.
(2) The number of mountable external cable lead-in apparatuses is as follows:
* Cable gland: 1 or 2
(3) As standard, two cable glands (G9601AJ) for the external cable lead-in apparatuses are mounted on the cable inlet ports for the power supply and output signal. On the remaining port, the blind plug (for heat insulation provided by steam heaters) or flexible tube (for heat insulation provided by electric heaters) is mounted.

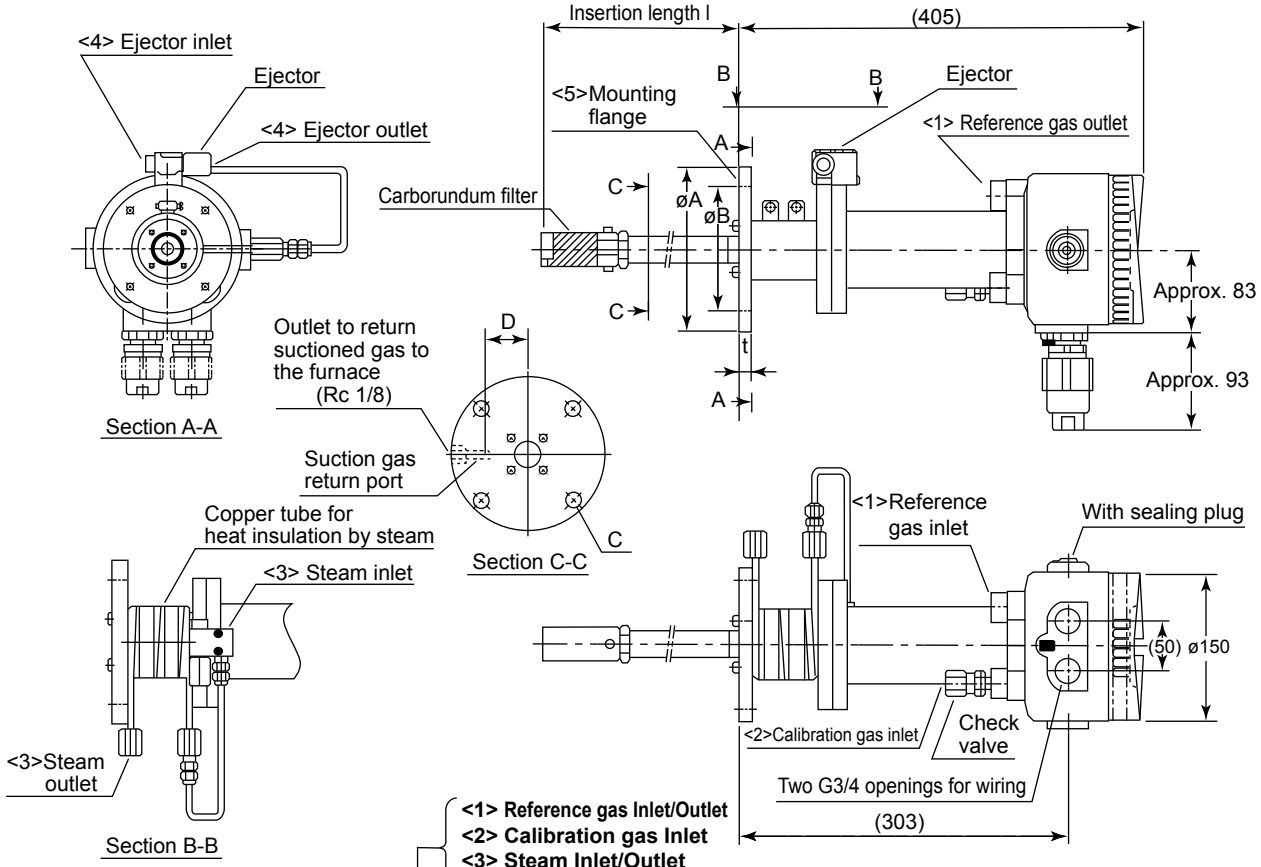
External Cable Lead-in Apparatuses

Name	Part No.	Description	Remarks
CABLE GLAND	G9601AJ	Cable O.D. ø10 to ø13.5	Cable gland

(3) External Dimensions

- **Flameproof General-purpose Detector (ZS8D-L-J-A-□-1-N-□-□□)**
  — Model for Steam Heater Providing Heat Insulation —

Unit: mm



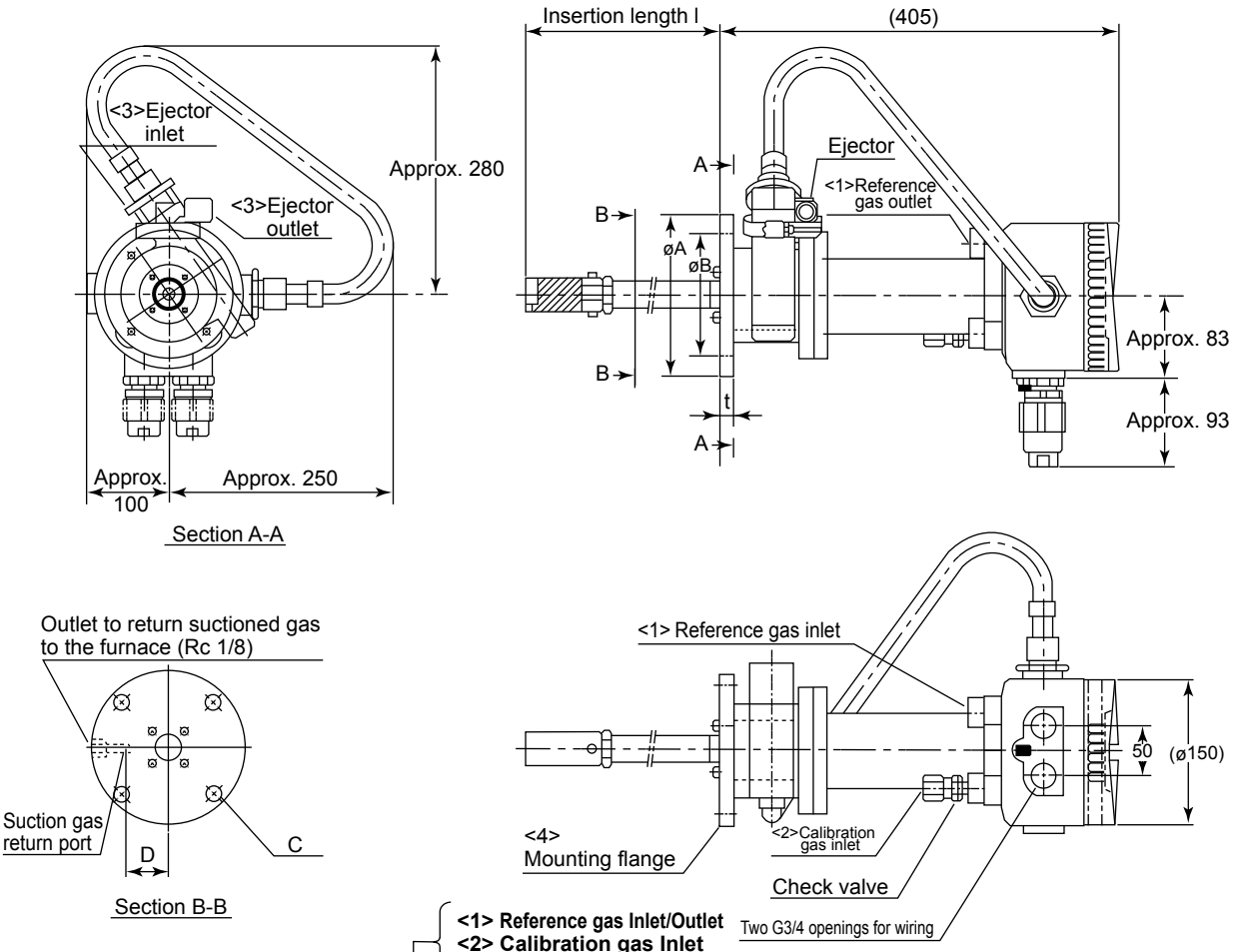
Note that the steam inlet and outlet positions may be changed.

F1.5E.ai

Model and Suffix Codes	Length l (mm)	Joint J :Rc1/4 A :1/4NPT	<5> Flange							
			Flange	ØA	ØB	C	D	t No return type	t Return type	Weight (kg)
ZS8D-L-J-A-050-1-N-□-J□	500	Rc1/4, 1/4NPT	JIS 10K-100-FF SUS304 (or equivalent)	210	175	8-ø19	41	18	18	Approx. 13
ZS8D-L-J-A-070-1-N-□-J□	700									Approx. 13.5
ZS8D-L-J-A-100-1-N-□-J□	1000									Approx. 14
ZS8D-L-J-A-150-1-N-□-J□	1500									Approx. 15
ZS8D-L-J-A-050-1-N-□-K□	500	Rc1/4, 1/4NPT	JPI CLASS 150-4-RF SUS304 (or equivalent)	229	190.5	8-ø19	41	24	24	Approx. 15
ZS8D-L-J-A-070-1-N-□-K□	700									Approx. 15
ZS8D-L-J-A-100-1-N-□-K□	1000									Approx. 16
ZS8D-L-J-A-150-1-N-□-K□	1500									Approx. 17
ZS8D-L-J-A-050-1-N-□-A□	500	Rc1/4, 1/4NPT	ANSI CLASS 150-4-RF SUS304 (or equivalent)	228.6	190.5	8-ø19	41	24	24	Approx. 15
ZS8D-L-J-A-070-1-N-□-A□	700									Approx. 15
ZS8D-L-J-A-100-1-N-□-A□	1000									Approx. 16
ZS8D-L-J-A-150-1-N-□-A□	1500									Approx. 17
ZS8D-L-J-A-050-1-N-□-E□	500	Rc1/4, 1/4NPT	DIN PN10-DN100-A SUS304 (or equivalent)	220	180	8-ø18	41	20	20	Approx. 12
ZS8D-L-J-A-070-1-N-□-E□	700									Approx. 13
ZS8D-L-J-A-100-1-N-□-E□	1000									Approx. 13
ZS8D-L-J-A-150-1-N-□-E□	1500									Approx. 14

● Flameproof General-purpose Detector (ZS8D-L-J-A-□-2-□-□-□□)
— Model for Electric Heater Providing Heat Insulation —

Unit: mm



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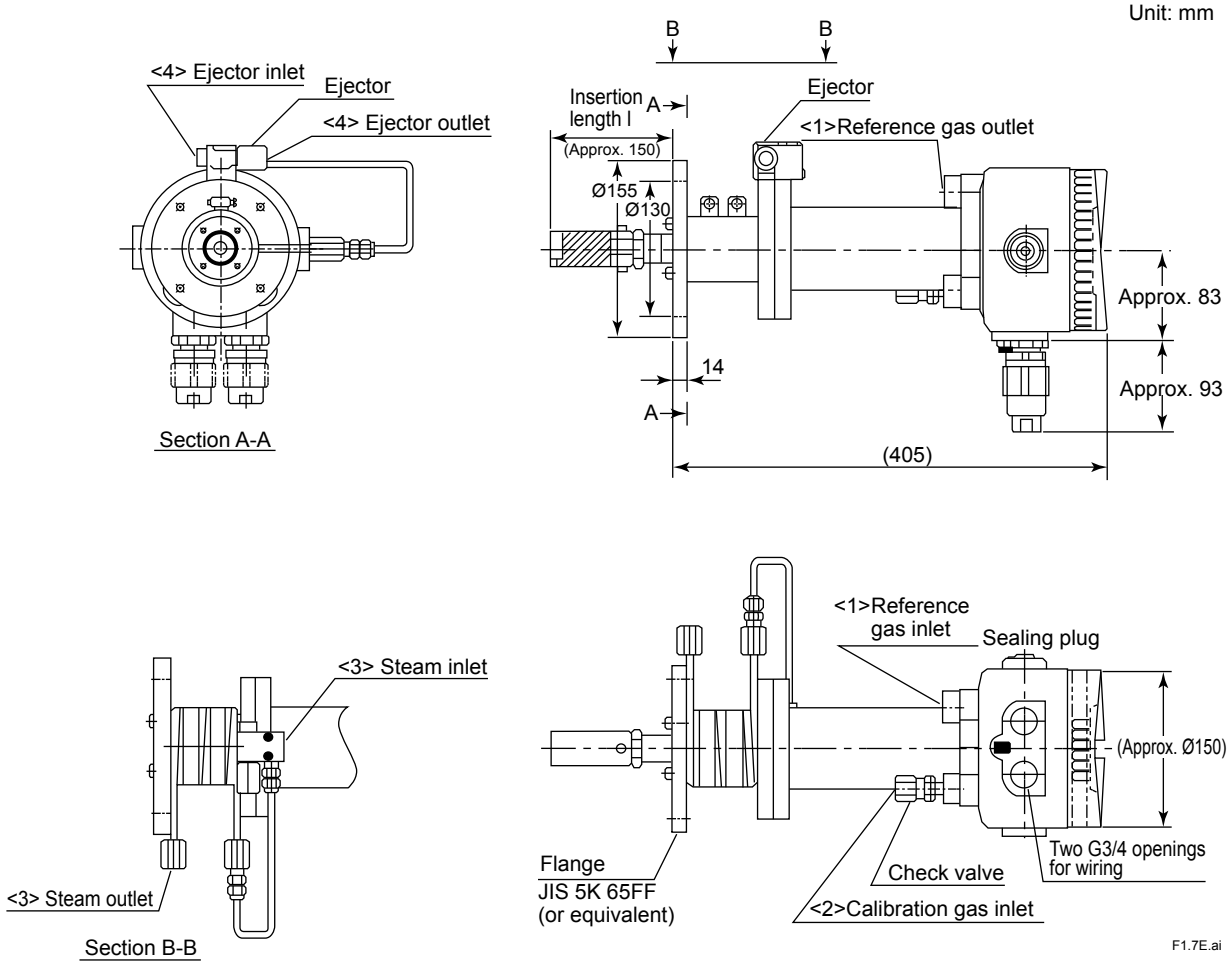
Model and Suffix Codes	Length l (mm)	Joint J :Rc1/4 A:1/4NPT	<4> Flange							
			Flange	ØA	ØB	C	D	t No return type	t Return type	Weight (kg)
ZS8D-L-J-A-050-2-□-□-J□	500	Rc1/4, 1/4NPT	JIS 10K-100-FF SUS304 (or equivalent)	210	175	8-ø19	41	18	18	Approx. 14
ZS8D-L-J-A-070-2-□-□-J□	700									Approx. 14.5
ZS8D-L-J-A-100-2-□-□-J□	1000									Approx. 15
ZS8D-L-J-A-150-2-□-□-J□	1500									Approx. 16
ZS8D-L-J-A-050-2-□-□-K□	500	Rc1/4, 1/4NPT	JPI CLASS 150-4 RFSUS304 (or equivalent)	229	190.5	8-ø19	41	24	24	Approx. 16
ZS8D-L-J-A-070-2-□-□-K□	700									Approx. 16
ZS8D-L-J-A-100-2-□-□-K□	1000									Approx. 17
ZS8D-L-J-A-150-2-□-□-K□	1500									Approx. 18
ZS8D-L-J-A-050-2-□-□-A□	500	Rc1/4, 1/4NPT	ANSI CLASS 150-4 RFSUS304 (or equivalent)	228.2	190.5	8-ø19	41	24	24	Approx. 16
ZS8D-L-J-A-070-2-□-□-A□	700									Approx. 16
ZS8D-L-J-A-100-2-□-□-A□	1000									Approx. 17
ZS8D-L-J-A-150-2-□-□-A□	1500									Approx. 18
ZS8D-L-J-A-050-2-□-□-E□	500	Rc1/4, 1/4NPT	DIN PN10-DN100-A SUS304 (or equivalent)	220	180	8-ø18	41	20	20	Approx. 13
ZS8D-L-J-A-070-2-□-□-E□	700									Approx. 14
ZS8D-L-J-A-100-2-□-□-E□	1000									Approx. 14
ZS8D-L-J-A-150-2-□-□-E□	1500									Approx. 15

● Flameproof High-temperature Detector (ZS8D-H-J-L-010-1-N-N-H□)
— Model for Steam Heater Providing Heat Insulation —

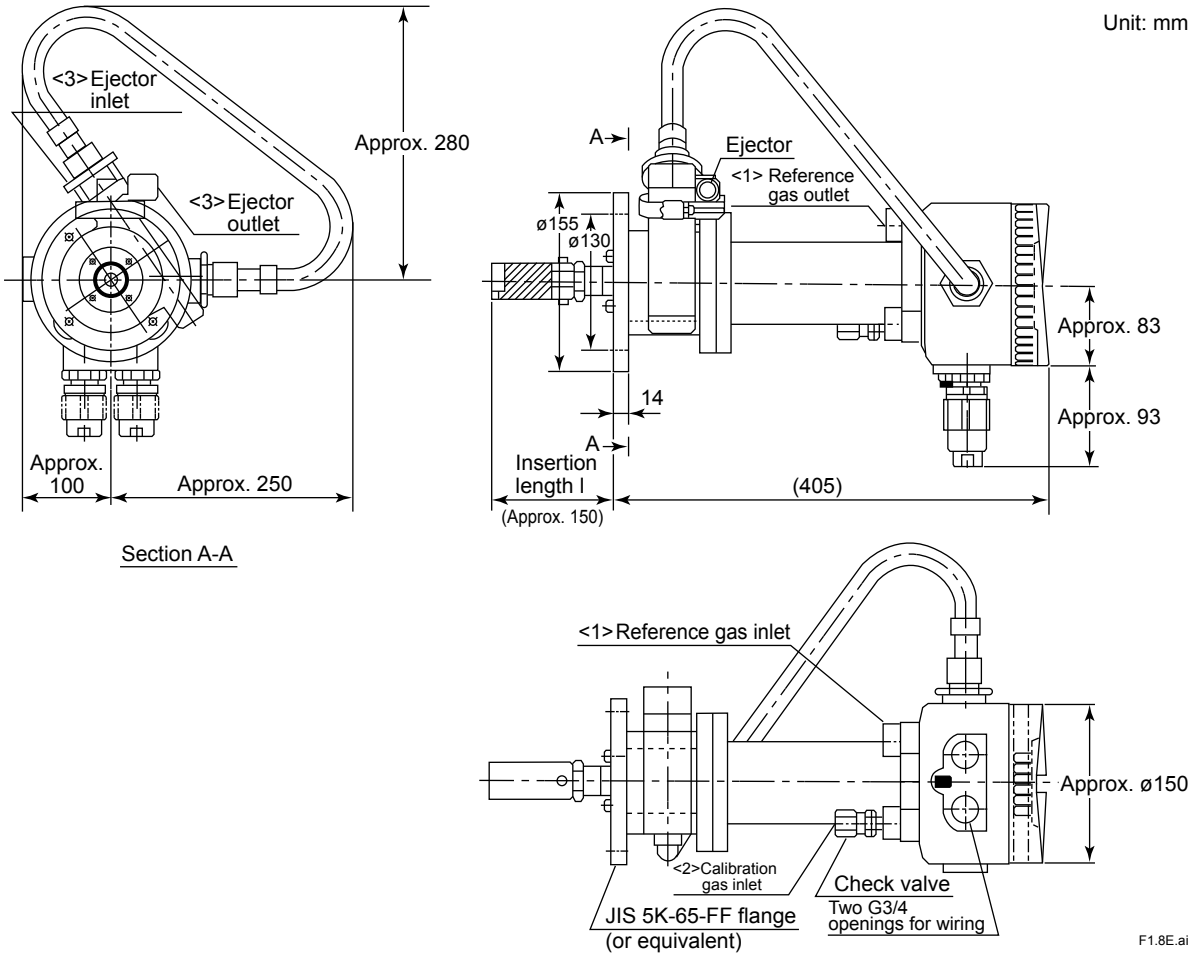
Unit: mm



Model and Suffix Codes	<1> Reference gas inlet/outlet	<2> Calibration gas inlet	<3> Steam inlet/outlet	<4> Ejector inlet/outlet	Weight (kg)
ZS8D-H-J-L-010-1-N-N-HJ	Rc1/4	Rc1/4	Rc1/4	Rc1/4	Approx. 10.3
ZS8D-H-J-L-010-1-N-N-HA	1/4NPT	1/4NPT	1/4NPT	1/4NPT	

- **Flameproof High-temperature Detector (ZS8D-H-J-L-010-2-☐-N-H☐)**
  — Model for Electric Heater Providing Heat Insulation—

Unit: mm



Model and Suffix Codes	<1> Reference gas inlet/outlet	<2> Calibration gas inlet	<3> Ejector inlet/outlet	Weight (kg)
ZS8D-H-J-L-010-2-☐-N-HJ	Rc1/4	Rc1/4	Rc1/4	Approx. 11.8
ZS8D-H-J-L-010-2-☐-N-HA	1/4NPT	1/4NPT	1/4NPT	

1.2.4 High Temperature Probe Adaptor ZS8P-H

(1) Specifications

The ZS8P-H probe adaptor is required for the ZS8D-H high-temperature probe.

Sample Gas Temperature: 0 to 800°C (when SUS310S probe is used)
800 to 1400°C (when SiC probe is used)

Sample Gas Pressure: −1.5 to +5 kPa

Insertion Length: 0.5 m, 0.7 m, 1.0 m,1.5m

Material in Contact with Gas: SiC or SUS 310S, SUS304, flange (SUS304)

Installation: Flange mounting (FF or RF type)

Flange; JIS 10K-100-FF SUS304, JPI Class 150-4-RF SUS304, ANSI Class 150-4-RF(no serration) SUS304, and DIN PN10-DN100-A SUS304.

Probe mounting angle; Vertically down (within ± 5°)
SUS310S probe can be mounted horizontally.

Case Material: SUS304, Aluminum alloy

Weight: With insertion length of 0.5 m, approx. 10 to 12 kg (JIS/JPI/ANSI/DIN)
0.7 m, approx. 10.5 to 12.5 kg (JIS/JPI/ANSI/DIN)
1 m, approx. 11 to 13 kg (JIS/ANSI)
1.5 m, approx. 12 to 14 kg (JIS/ANSI)

(2) Model and Suffix Codes

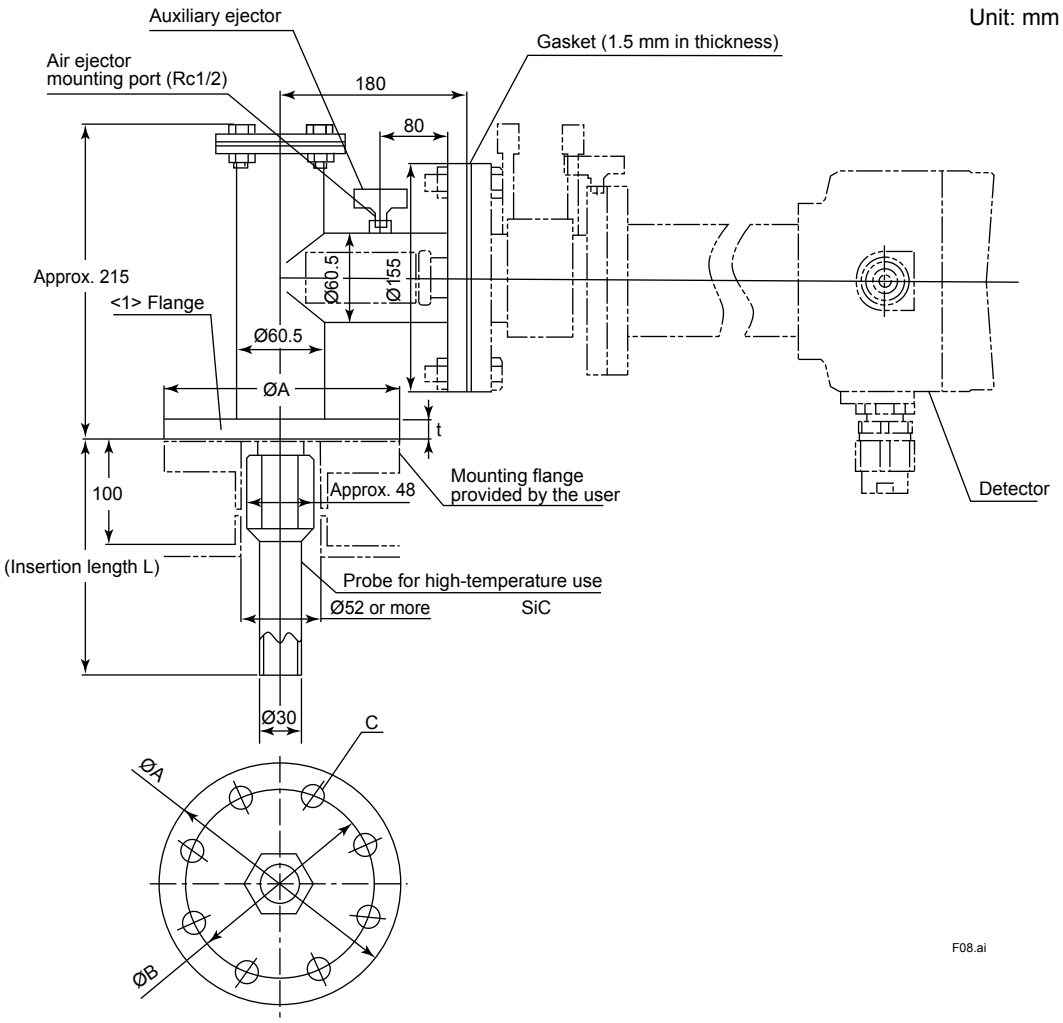
[Style: S2]

Model	Suffix code	Option code	Description
ZS8P	-H	·····	High Temperature probe adaptor
Probe material	-A	·····	SUS310S (0° to 800°C)
	-B	·····	SiC (800 to 1400°C) (*1)
Insertion length	-050	·····	0.5m
	-070	·····	0.7m
	-100	·····	1.0m
	-150	·····	1.5m
Sample gas (exhaust method)	-0	·····	Discharge outside furnace (*2)
Flange joint connection	-J	·····	JIS 10K-100-FF SUS304
	-K	·····	JPI Class 150-4-RF SUS304
	-A	·····	ANSI Class 150-4-RF SUS304
	-E	·····	DIN PN10-DN100-A SUS304
Ejector inlet joint (*3)	J	·····	Rc1/4 (specified for JIS and JPI flanges)
	A	·····	1/4NPT (specified for ANSI and DIN flanges)
Heat insulation jacket		/JP	For probe adaptors
Tag plate		/SCT	Stainless steel tag plate

(*1) If the temperature inside the furnace is 800°C or more, select -B.
(*2) Select whether to discharge mixed gases (the sample gas sucked in by the ejector plus the ejector air) outside the furnace or to recirculate them in the furnace.
(*3) The probe adaptor is equipped with an auxiliary ejector assembly as standard.

(3) External Dimensions

Unit: mm



Model and Suffix Codes	Insertion Length l (mm)	<1>Flange (mm)					Weight (kg)
		Flange	ØA	ØB	C	t	
ZS8P-H-☐-050-0-JJ	500	JIS 10K-100-FF SUS304 (or equivalent)	210	175	19 dia. 8 holes	18	Approx. 10 kg
ZS8P-H-☐-070-0-JJ	700						Approx. 10.5 kg
ZS8P-H-☐-100-0-JJ	1000						Approx. 11.0 kg
ZS8P-H-☐-150-0-JJ	1500						Approx. 12.0 kg
ZS8P-H-☐-050-0-KJ	500	JPI CLASS 150-4-RF SUS304 (or equivalent)	229	190.5	19 dia. 8 holes	24	Approx. 12.0 kg
ZS8P-H-☐-070-0-KJ	700						Approx. 12.5 kg
ZS8P-H-☐-100-0-KJ	1000						Approx. 13.0 kg
ZS8P-H-☐-150-0-KJ	1500						Approx. 14.0 kg
ZS8P-H-☐-050-0-AA	500	ANSI CLASS 150-4-RF SUS304 (or equivalent)	228.6	190.5	19 dia. 8 holes	24	Approx. 12.0 kg
ZS8P-H-☐-070-0-AA	700						Approx. 12.5 kg
ZS8P-H-☐-100-0-AA	1000						Approx. 13.0 kg
ZS8P-H-☐-150-0-AA	1500						Approx. 14.0 kg
ZS8P-H-☐-050-0-EA	500	DIN PN10-DN100-A SUS304 (or equivalent)	220	180	19 dia. 8 holes	20	Approx. 10.5 kg
ZS8P-H-☐-070-0-EA	700						Approx. 11.0 kg
ZS8P-H-☐-100-0-EA	1000						Approx. 11.5 kg
ZS8P-H-☐-150-0-EA	1500						Approx. 12.5 kg

1.2.5 Flameproof Converter ZS8C

(1) Specifications

Display Section: Measured value display section: 4-digit LED; Talk and response display: 40-character dot matrix LCD with backlight

Display Content:

LED; Oxygen concentration (vol%), error code display

LCD; Measured value group A (1st level)

Analog bar (output range, alarm setpoints, simultaneous display), max./min. oxygen values, average value (period setting possible), cell emf (mV), clock (year/month/day/hour/minute)

Measured value group B (2nd level)

Span correction rate/record, zero correction rate/record, cell response time (sec.), cell resistance (Ω), cell condition, estimated cell life-span, heater on-time rate

Setpoint group C (calibration related)

Calibration gas concentration (%O_2), calibration mode (one-touch, semi-automatic, automatic), stabilization time , calibration time, calibration cycle, calibration start time

Setpoint group D (output related)

Output range 1,2 (%O_2), presence or absence of output hold/ preset value, analog output smoothing constant

Setpoint group E (alarm)

HH alarm, H alarm, LL alarm and L alarm setpoints, contact output delay (sec.)/hysteresis (% span)

Status message group

Self-diagnosis, calibration, warm-up, stabilization, abnormal content

Talk and response message group

Calibration operation indicator, component check indicator, password entry indicator

Help message:

Information supplementary to display content

Analog Output Signal:

4 to 20 mA DC (max. load resistance 550Ω), Input/output isolation

Range; any settings between 0 to 5 through 0 to 25 vol%O_2; switching between 2 ranges by external contact input possible (optional); partial range possible (span/zero rate ≥ 1.3)

Output dumping; 0 to 255 seconds

Dumping released during abrupt output change (releasing range: 0 to 3.0 vol%)

Hold/non-hold selection, preset value setting possible at hold

Contact output signal:

3 points, contact capacity 30 V DC 2A, 250 V AC 2A (resistive load)

Fail-safe condition (normally energized/normally de-energized) selectable, NO/NC selectable using jumper pin

Delay function (0 to 255 sec.) and hysteresis function (0 to 25vol%O_2) can be set for Hi/Lo alarm.

The following functions are programmable for each
contact output; (1) Abnormal (self-diagnosis) (2) HiHi alarm (3) Hi alarm (4) LoLo alarm (5) Lo alarm (6) Entry (7) Range switching answerback (8) Warm-up (9) Reduction of calibration-gas pressure (repeat output of contact input) (10) Calibration (11) Blow-back

If any combination is applicable during default, the contact points will operate.

Contact point 1; NC, normally energized (1) Abnormal

Contact point 2; NO, normally de-energized (6) Entry + (10) Calibration + (8) Warm-up

Contact point 3; NO, normally de-energized, (3) Hi alarm + (5) Lo alarm

Contact Output for Solenoid Valve:

Solid State Relay (Triac) output: 2 points

Contact capacity; 250 V AC, 1 A

Leakage current at SSR OFF; 3 mA or less

Contact output for ejector air stop solenoid valve:

Contact capacity; 250 V AC, 1 A (load resistance)

* In the case of a probe with electric heaters, if the heater temperature falls below ±10°C against setting temperature for some reason (or if the power goes off), the ejector stops.

Serial communications: with an RS-422-A interface

Self-diagnosis: Abnormal cell, abnormal cell temperature (low)(high), abnormal analog circuit, abnormal calibration, abnormal ROM/RAM, power failure

Contact Input (optional):
2 points, isolated

Contact input or voltage input

	ON	OFF
Contact input	200 Ω or less	100 kΩ or more
Voltage input	−1 to +1 V DC	−4.5 to +2.5 V DC or more

The following functions are programmable for each contact input:
(1) Reduction of calibration-gas pressure
(2) Range switching
(3) External calibration start
(4) Process abnormal alarm
(5) Blow-back start

Calibration:
Calibration method; One-touch, automatic/semi-automatic (optional)
All are operated by a talk-and-response procedure with the LCD panel. With automatic/semi-automatic, either zero or span can be skipped.

Calibration-gas concentration setting range;
0.3 to 25 vol%O_2
(minimum setting unit: 0.01 vol%O_2)
Use the standard zero and span gases which are gas mixtures of nitrogen and about 10% oxygen for an 80 to 100% scale.

Ambient Temperature: −20 to +55°C

Power Supply: 100, 115, 220, 240 V AC +10%, −15%, 50/60 Hz

Construction: JIS C0920 waterproof, NEMA3 or equivalent (when the openings for conduits are completely sealed)

Power Connection Inlet: Seven G3/4 holes

Air-purge: Rc1/4 or 1/4NPT(F) connection (optional)
Approx. 1 l/min. at 50 kPa
Note that the number of the power connection inlets becomes six when purging.

Installation: Wall or pipe mounting

Case: Aluminum alloy

Paint Colors: 0.6GY3.1/2.0 (for instrument front cover) and 2.5Y8.4/1.2 (instrument case)

Paint: Baked epoxy resin

Weight: Approx. 19 kg (100 to 115 V AC)
Approx. 20.5 kg (220 to 240 V AC)

(2) Model and Suffix Codes

Model	Suffix code	Option code	Description
ZS8C	· · · · · · · · · · · · · · · · ·	· · · · · · · ·	Converter
Flameproof standard	-J	· · · · · · · ·	Exd II BT6 (Max. surface temperature 85°C)
Power supply	-3	· · · · · · · ·	220V AC, 50/60Hz
	-4	· · · · · · · ·	240V AC, 50/60Hz
	-5	· · · · · · · ·	100V AC, 50/60Hz
	-8	· · · · · · · ·	115V AC, 50/60Hz
Auxiliary heater thermostat for probe (*1)	-0	· · · · · · · ·	For detector heat insulation provided by steam heaters
	-1	· · · · · · · ·	For detector heat insulation provided by electric heaters
Panel	-E	· · · · · · · ·	English
	-J	· · · · · · · ·	Japanese
Wall mounting		/W	With wall mounting bracket
		/P	With pipe mounting bracket
Air-purge connection		/AP2	1/4NPT(F)
		/AP1	Rc1/4

(*1) A steam heater [-0] must be specified when heavy oil fuel, gas and heavy oil fuel mixture is used or clew point temperature of exhaust gas is about 130°C.

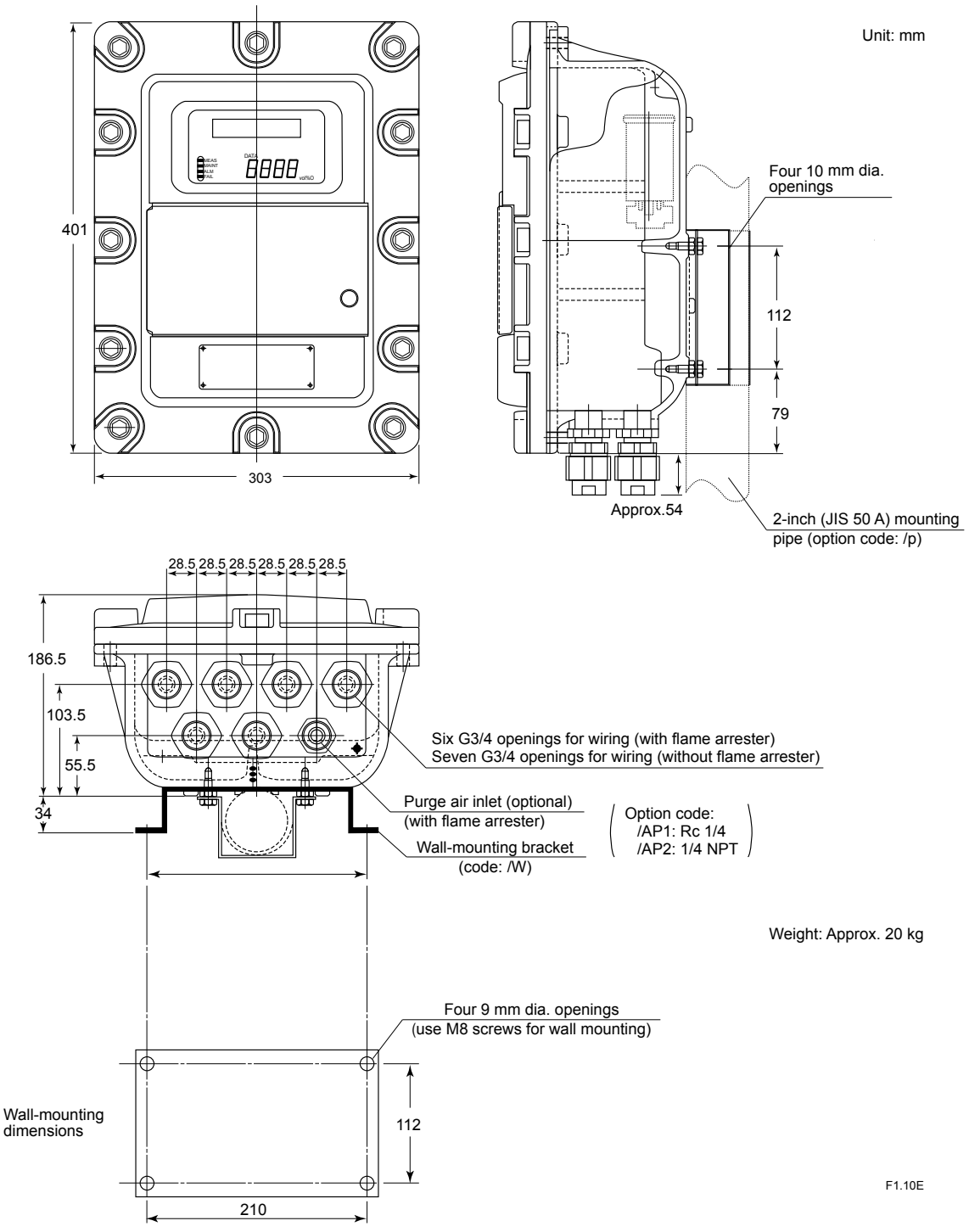
(Notes)

(1) Always use the specified external cable lead-in apparatuses given in the table below.
(2) The number of mountable external cable lead-in apparatuses is as follows:
* Cable gland: up to 7
(3) As standard, three cable glands (G9601AE) for the external cable lead-in apparatuses are mounted on the cable inlet ports for the power supply and output signal. On the remaining four ports, blind plugs are mounted.
(4) If any signal other than the power supply and output signal is required, additionally prepare the following parts as necessary

External Cable Lead-in Apparatus

Name	Part No.	Description	Remarks
CABLE GLAND	G9601AE	Cable O.D. ø10 to ø13.5	Cable gland

(3) External Dimensions



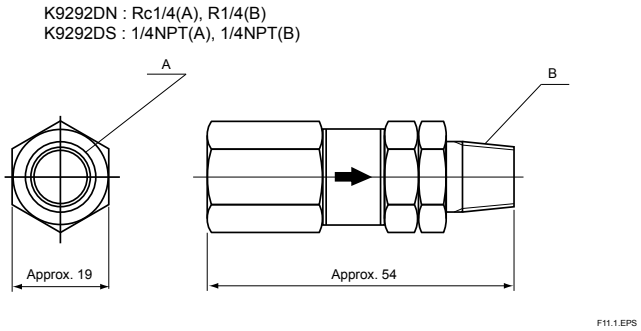
1.2.6 Options

(1) Check Valve K9292DN/K9292DS

This is used to prevent entry of the process gas into the calibration-gas line. It is incorporated in the product as standard. If it is necessary to have one as a spare part, select it according to the specifications.

Connection:	Rc1/4 or 1/4NPT (F) (R1/4 or 1/4NPT (M) connectable)
Material:	SUS304
Supply Pressure:	Between 150 kPa to 350 kPa
Weight:	Approx. 40 g

Unit: mm



(2) Auxiliary Ejector Assembly K9292VA/K9292VB (for detector) K9292WA/K9292WB (for probe adaptor)

Assemblies for both the detector and probe adaptor are available. If it is necessary to have one as a spare part, select it according to the specifications.

- **Ejector Joint**
  K9292VE/K9292VF (for detector)
  K9292WC/K9292WD (for probe adaptor)

Ejector Air Pressure:	20 kPa for detector 98 kPa for probe adaptor
Air Consumption:	4 l/min. for detector 40 l/min. for probe adaptor
Connection:	Rc1/4 or 1/4NPT(F)
Material:	SUS304
Tube Connection:	(ø6/ø4 or 1/4-inch copper or stainless-steel tubing)

- **Pressure Gauge Assembly**

Pressure Gauge Type: JIS B7505, A1.5U3/8X75

Material in Contact with Gas: SUS316

Case Material:	Aluminum alloy (painted in black)
Scale:	0 to 50 kPa (K9292VA/VB for detector) 0 to 200 kPa (K9292WA/WB for probe adaptors)
Tube Connections:	Rc1/4 or 1/4NPT, SUS304

- **Needle Valve**

Connection: Rc1/4 or 1/4NPT(F)

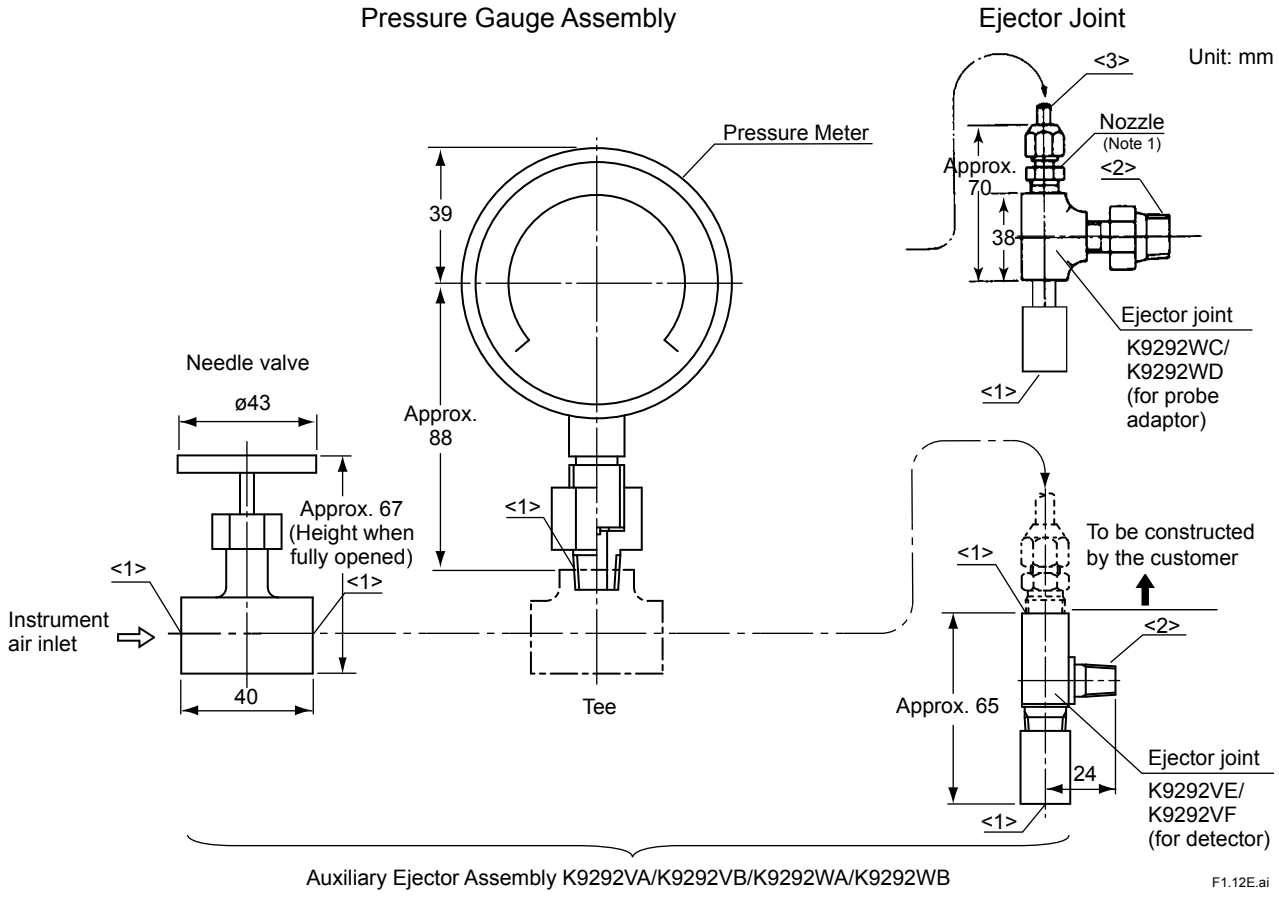
Material: SUS316

(Note) Pipes and connectors other than the above are not supplied.

- **Part No.**

Part No.	Part No.
K9292VB	Auxiliary ejector assembly for detector, 1/4NPT with a pressure gauge and needle valve
K9292VA	Auxiliary ejector assembly for detector, Rc1/4 with a pressure gauge and needle valve
K9292VF	Ejector joint (for auxiliary ejectors), 1/4 NPT
K9292VE	Ejector joint (for main ejectors), Rc1/4
K9292WB	Auxiliary ejector assembly for probe adaptors, 1/4 NPT, with a pressure gauge and needle valve
K9292WA	Auxiliary ejector assembly for probe adaptors, Rc1/4, with a pressure gauge and needle valve
K9292WD	Ejector joint (for probe adaptor), 1/4NPT
K9292WC	Ejector joint (for probe adaptor), Rc1/4

- **External Dimensions**



Parts number	Specification	<1>	<2>	<3>
K9292VA	For Detector use	Rc1/4	R1/8	—
K9292VB	For Detector use	1/4NPT	R1/8	—
K9292WA	For Probe adaptor use	Rc1/4	R1/2	Pipe O.D. ø6
K9292WB	For Probe adaptor use	1/4NPT	R1/2	Pipe O.D. ø1/4

(Note 1) The connector of auxiliary ejector assembly is a dedicated connecter with nozzle function.

(3) Flow Setting Unit ZA8F

- **Specifications**

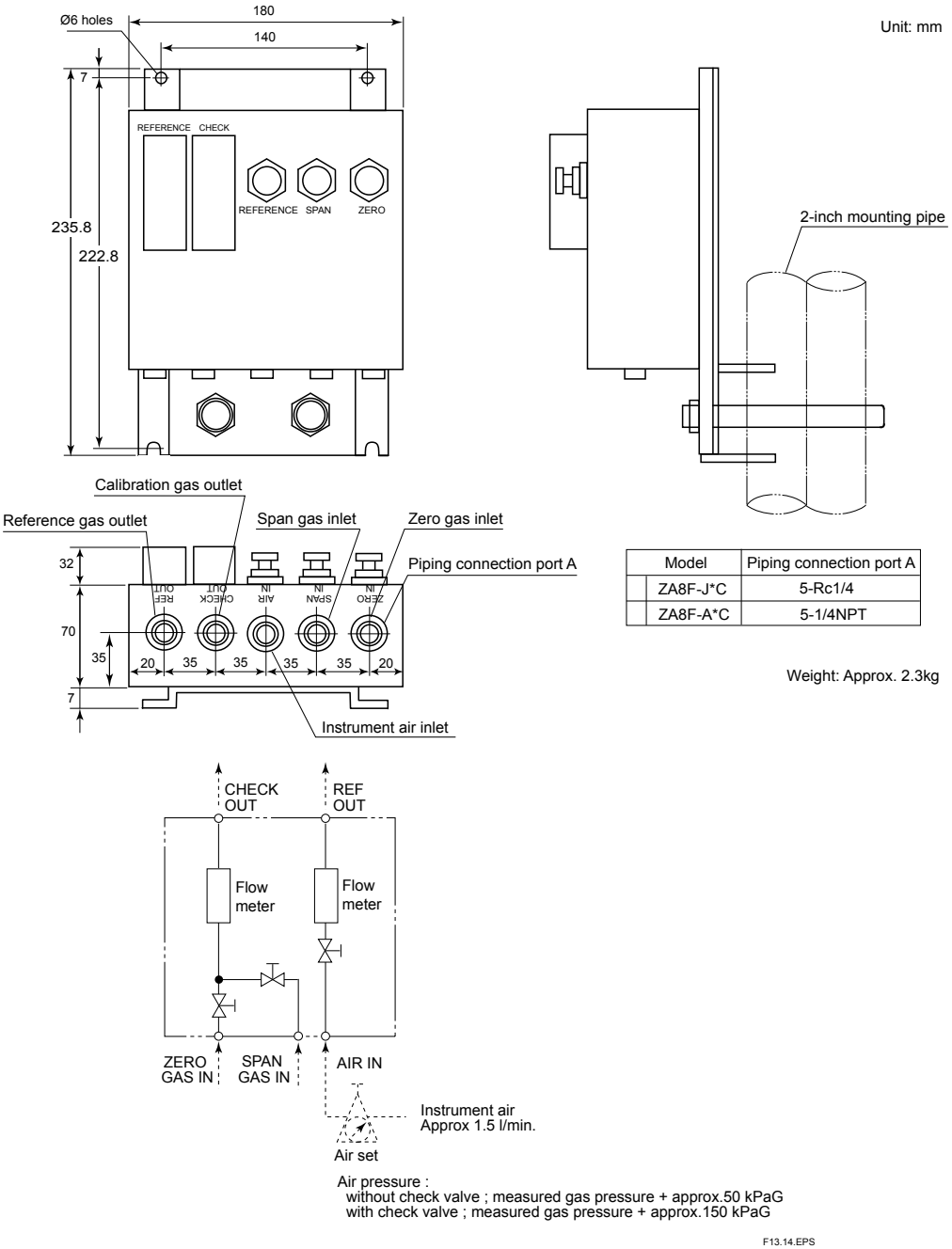
Used when instrument air is provided. This unit controls flow rates of calibration gas and reference gas and consists of flowmeter and flow rate control valve.

Flowmeter:	Calibration gas; 0.1 to 1.0 l/min. Reference air; 0.1 to 1.0 l/min.
Construction:	Dust-proof and rainproof construction
Case Material:	SPCC (Cold rolled steel sheet)
Painting:	Baked epoxy resin, Dark-green (Munsell 2.0 GY 3.1/0.5 or equivalent)
Tube Connections:	Rc1/4 or 1/4NPT (F)
Reference Air pressure:	Clean air supply of measured gas pressure plus approx. 50 kPa G measured gas pressure plus approx.150 kPa (maximum pressure rating is 300 kPa) when a check valve is used (pressure at inlet of the auto-calibration unit)
Air Consumption:	Approx. 1.5 l/min
Weight:	Approx. 2.3 kg

- **Model and Suffix Codes**

Model	Suffix code	Option code	Description
ZA8F	· ·	· · · · · · · ·	Flow setting unit
Joint	-J	· · · · · · · ·	Rc1/4
	-A	· · · · · · · ·	1/4NPT (F) with adaptor
Style code	*C	· · · · · · · ·	Style C

- **External Dimensions**



Model	Piping connection port A
ZA8F-J*C	5-Rc1/4
ZA8F-A*C	5-1/4NPT

(4) Air Set G7003XF/K9473XK

- **Specifications**

Primary Pressure: Max. 1 MPa G

Secondary Pressure: 0 to 200 kPa G

Connection: Rc1/4 or 1/4NPT (F)

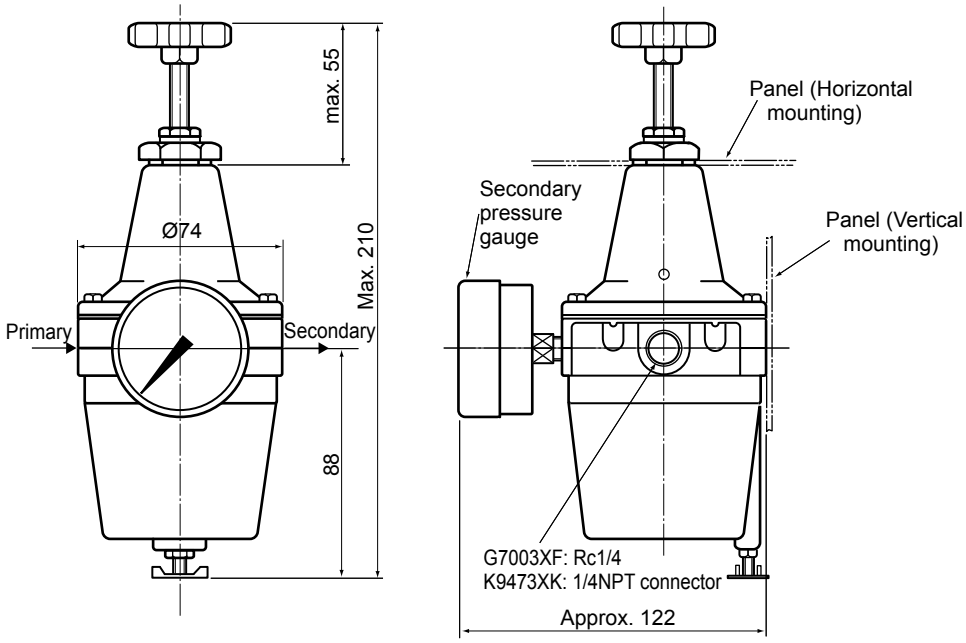
Material: Zn alloy

- **Part No.**

Part No. / Description	G7003XF	K9473XK
Primary Pressure	Max. 1 MPa G	Max. 1 MPa G
Secondary Pressure	0 to 200 kPa G	0 to 200 kPa G
Connection	Rc1/4	1/4NPT with adaptor
Material	Zn alloy	Zn alloy

- **External dimensions**

Unit: mm



weight: 1.0 kg

Air Set (G7003XF/K9473XK) F1.14E.ai

(5) Calibration Gas Unit

This unit consists of a zero-gas cylinder, pressure regulator, and case assembly.

- **Zero Gas Cylinder G7001ZC**

Capacity: 3.4 l

Filled Pressure: 9.8 to 12 MPa G

Gas Composition: 0.95 to 1.0 vol% O_2 + N_2 balance

- **Cylinder Pressure Regulator G7013XF/G7014XF**

Pressure Gauge:

Primary; 0 to 14.8 MPa G

Secondary; 0 to 0.4 MPa G

Connection:

Inlet; W22 14 threads, right-hand screw

Outlet; Rc1/4 or 1/4NPT (F)

Body Material: Brass

- **Case Assembly E7044KF**

Case Material: SPCC

Case Paint: Baked epoxy resin

Paint Color: Jade green (Munsell 7.5BG 4/1.5)

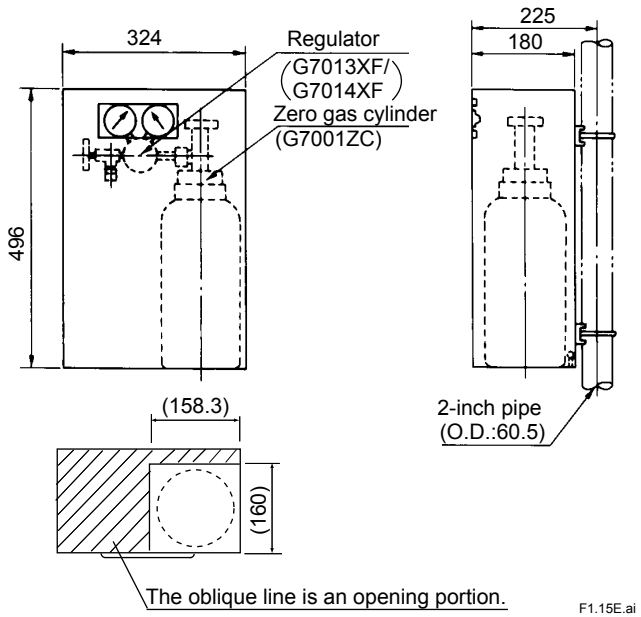
Mounting: Two-inch pipe mounting

Weight: Approx. 3.6 kg

- **External dimensions**

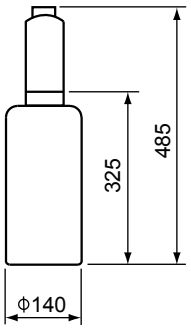
Calibration Gas Unit

Unit: mm



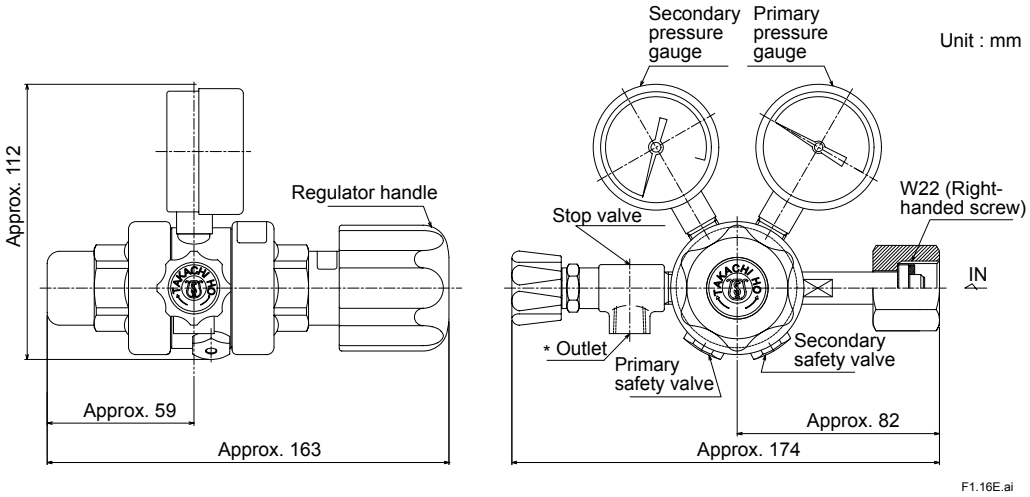
Note: The zero gas cylinder and the regulator valve are not included in the E7044KF (case assembly)

G7001ZC Zero-gas Cylinder



(Note) Export of such high pressure filled gas cylinders to most countries is prohibited or restricted.

Cylinder Pressure Regulator



Part No.	* Inlet/Outlet
G7013XF	W22 14 threads/ Rc1/4
G7014XF	W22 14 threads/ 1/4 NPT (F)

Weight: Approx. 1kg

2. Installation

This analyzer is an instrument of flameproof construction and has been certified by a public agency based on the Industrial Safety and Health Law (of Japan). For the wiring and piping work in the case of installing this analyzer in a hazardous area, do the work in accordance with the see USER'S GUIDELINES for Electrical Installation for Explosive Gas Atmospheres in General Industry, issued by the Research Institute of Industrial Safety of the Ministry of Labor in Japan, 1994.

This chapter describes procedures for installation of the major units composing the ZS8 flameproof zirconia oxygen analyzer (including those in optional use) as shown below.

Section 2.1 Flameproof general-purpose detector

Section 2.2 Flameproof high-temperature detector (including high-temperature probe adaptor)

Section 2.3 Flameproof converter

Section 2.4 Flow setting unit

Section 2.5 Calibration gas unit case

2.1 Installation of Flameproof General-purpose Detector

2.1.1 Installation Site

The following criteria should be taken into consideration when selecting the location for installing the detector.

(1) The explosion protection standards are satisfied.

(2) There should be easy access to the detector to ensure safe work in checking and maintenance.

(3) The ambient temperature should not be too high (below 60°C) and the terminal box should not be subject to strong radiant heat.

(4) There should be no vibration.

2.1.2 Probe Insertion Hole

When constructing the probe insertion hole, take the following into consideration:

(1) Do not point the detector probe tip upward.

(Note) This should be observed so that the sensor (cell) in the probe tip is not affected by droplets which may cause problems such as condensation.

(2) Mount the detector probe at a right angle to the measuring gas flow or with the probe tip located on the downstream side.

(3) If the vent gas is to be returned to the inside of the furnace using a general-purpose detector, devise the mounting flange pipe so that its inner surface is placed outer than the ejector air return port position because the return port radius is 41 mm.
Also, place the filter root position 30 mm or more away from the inner surface of the furnace wall. If it is less than this distance, if may be affected with the ejector's return air.

(4) Adjustment of deflector mounting direction
Adjust the position of the filter protector (deflector) of the probe tip so that it is a right angle to the gas flow as shown in Figure 2.1 for both general-purpose and high-temperature detectors. The deflector direction can be readily changed by loosening the lock nut on the probe tip. Figure 2.1 shows an example of probe insertion hole construction work.

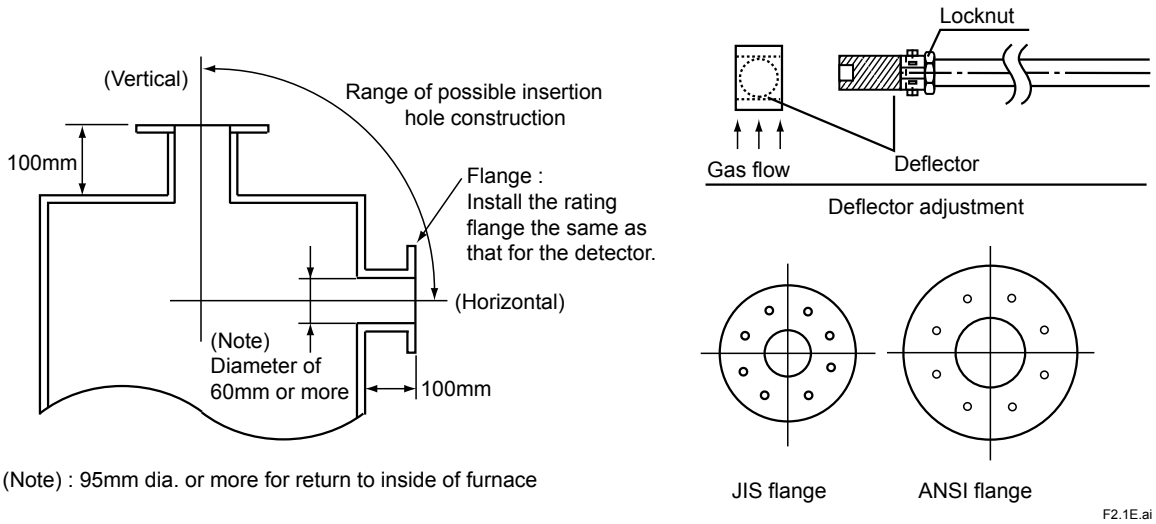


Figure 2.1 Example of Probe Insertion Hole Construction Work

2.1.3 Detector Installation

In the detector, zirconia (ceramic) is used as a sensor. Be careful not to subject the sensor to strong shock such as from being dropped, when the detector is installed.

Prepare and use a gasket on the tie-in flange surface to prevent gas leakage. It is required that the gasket material be heat-resistant and corrosion-resistant conforming to the properties of the measuring gas. Table 2.1 shows the parts which are necessary for installing the detector.

Table 2.1 Parts Necessary for Installing the Detector

Mounting flange rating	Part	Quantity	Remarks
JIS 10K-100-FF	Gasket	1	The gasket should be heat-resistant and corrosion-resistant.
	Bolts (M16 x 80)	8	
	Nuts (M16)	8	
	Washer (for M16)	16	
JPI CLASS150-4-RF	Gasket	1	The gasket should be heat-resistant and corrosion-resistant.
	Bolts (5/8-11UNC x 80)	8	
	Nuts (5/8-11UNC)	8	
	Washer (for 5/8-11UNC)	16	
DIN PN10-DN100-A	Gasket	1	The gasket should be heat-resistant and corrosion-resistant.
	Bolts (M16 x 80)	8	
	Nuts (M16)	8	
	Washer (for M16)	16	

The following is a point to be taken into consideration in installation work:

(Flameproof Detector)

If the detector is to be mounted horizontally, point the cable inlet port downward.

2.1.4 Reference Air Outlet

Do not block the reference air outlet. Otherwise, the terminal box inner pressure increases and an indication error may occur. To prevent rain water from entering through the reference air outlet, you can connect a short pipe (100 mm maximum) with a minimum of 6-mm ID to the outlet.

2.1.5 Heat Insulation

CAUTION

For explosion protection standards, the lagging surface temperature must be 200°C or less.

The path of the gas flow in the probe must be heat-insulated above the dew point to prevent clogging due to condensation.

a. Heat-insulate the flame arresters at both the measuring gas inlet and outlet using an electric heater. Make the heat insulation temperature above the dew point and at 195°C or less. The electric heater or steam trace copper tubing can be supplied optionally.

b. Heat-insulate the mating flange section so that the inside of the measuring gas suction pipe does not drop below the dew point using steam tracing.

c. Also heat-insulate the air ejector so that it is above the dew point. As the strength of the measuring gas suction is weak (about 300 ml/min, supply an air flowrate of about 3 l/min), there will be no problem in heat insulation by using lagging only, except when the ambient temperature is extremely low. Prevent rain water from entering the air ejector.
In addition, the problem of supply air piping clogging is better solved by heating the piping by winding it around the detector heater section before connecting it to the ejector.

d. Cover the heat-insulating section by steam trace or the electric heater with ceramic wool or the like to enhance the heat insulation effect.

2.2 Installation of Flameproof High-temperature Detector

2.2.1 Installation Site

Install the flameproof high-temperature detector in a location where:

(1) the explosion protection standards are satisfied.

(2) there is easy access to the detector and safe work is ensured in checking and maintenance,

(3) the ambient temperature is below 60°C and the terminal box is not subject to radiant heat.

(4) there is no vibration.

2.2.2 Probe Insertion Hole

The ZS8D-H flameproof high-temperature detector is used in combination with the ZS8P-H high-temperature probe adaptor. If this high temperature detector is to be used, provide the probe insertion hole for the high temperature probe adaptor.

When constructing the probe insertion hole, take the following into consideration:

(1) If the high-temperature probe adaptor is made of silicon carbide (SiC), construct the hole so that the probe is placed vertically (tilting: within 5 degrees).

(2) If the high-temperature stainless steel probe adaptor is to be installed horizontally, the probe tip should not be higher than the flange center.
Figure 2.2 shows examples of constructing the probe insertion hole.

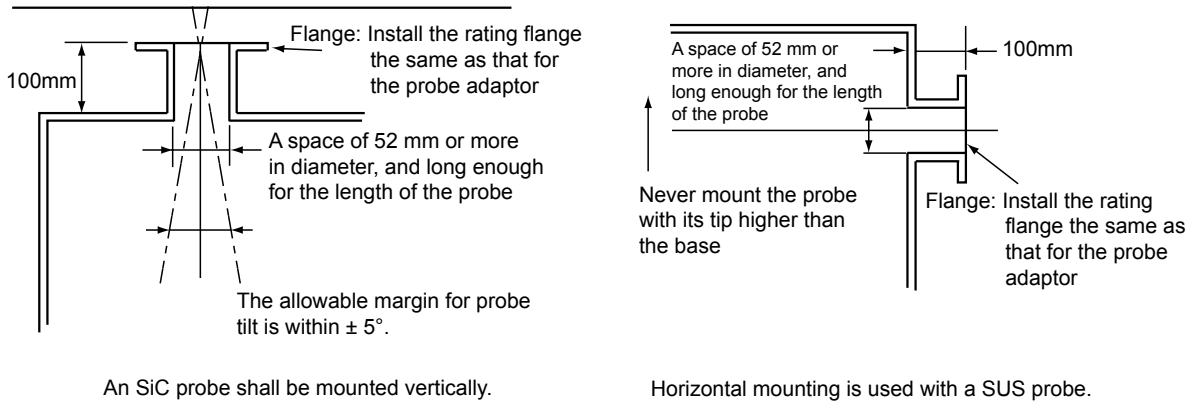

Flange: Install the rating flange the same as that for the probe adaptor
100mm
A space of 52 mm or more in diameter, and long enough for the length of the probe
The allowable margin for probe tilt is within ± 5°.
A space of 52 mm or more in diameter, and long enough for the length of the probe
100mm
Never mount the probe with its tip higher than the base
Flange: Install the rating flange the same as that for the probe adaptor
An SiC probe shall be mounted vertically.
Horizontal mounting is used with a SUS probe.
F2.2E.ai

Figure 2.2 Examples of Probe Insertion Hole Construction

2.2.3 Detector Installation

In the detector, zirconia (ceramic) is used as the sensor. Be careful not to subject it to strong shock such as from being dropped, when the detector is installed. The same caution applies to a high-temperature SiC probe adaptor.

Provide a gasket on the tie-in flange surface to prevent gas leakage. It is required that the gasket material be heat-resistant and corrosion-resistant conforming to the properties of the measuring gas. Table 2.2 shows the parts which are necessary for installing a high-temperature probe adaptor.

Table 2.2 Parts Necessary for Installing High Temperature Probe Adaptor

Mounting flange rating	Part	Quantity	Remarks
JIS 10K-100-FF	Gasket	1	The gasket should be heat-resistant and corrosion-resistant.
	Bolts (M16 x 80)	8	
	Nuts (M16)	8	
	Washer (for M16)	16	
JPI CLASS150-4-RF	Gasket	1	The gasket should be heat-resistant and corrosion-resistant.
	Bolts (5/8-11UNC x 80)	8	
	Nuts (5/8-11UNC)	8	
	Washer (for 5/8-11UNC)	16	
DIN PN10-DN100-A	Gasket	1	The gasket should be heat-resistant and corrosion-resistant.
	Bolts (M16 x 80)	8	
	Nuts (M16)	8	
	Washer (for M16)	16	

The following is a point to be taken into consideration in installation work:

(1) Install the high-temperature detector considering the attitude of the detector. In particular, if it is to be installed horizontally, be careful that the detector probe tip is not pointed upward (it is recommended that detector be installed vertically unless otherwise restricted by the location).

(2) When mounting the high-temperature probe adaptor, be sure to insert a gasket between the flange surfaces to prevent gas leakage. Special care should be taken for air-tightness, if there is negative pressure in the furnace, to prevent air leakage into the furnace.

(3) When installing the detector with an attitude other than vertical, do it so that the cable inlet port is pointed downward.

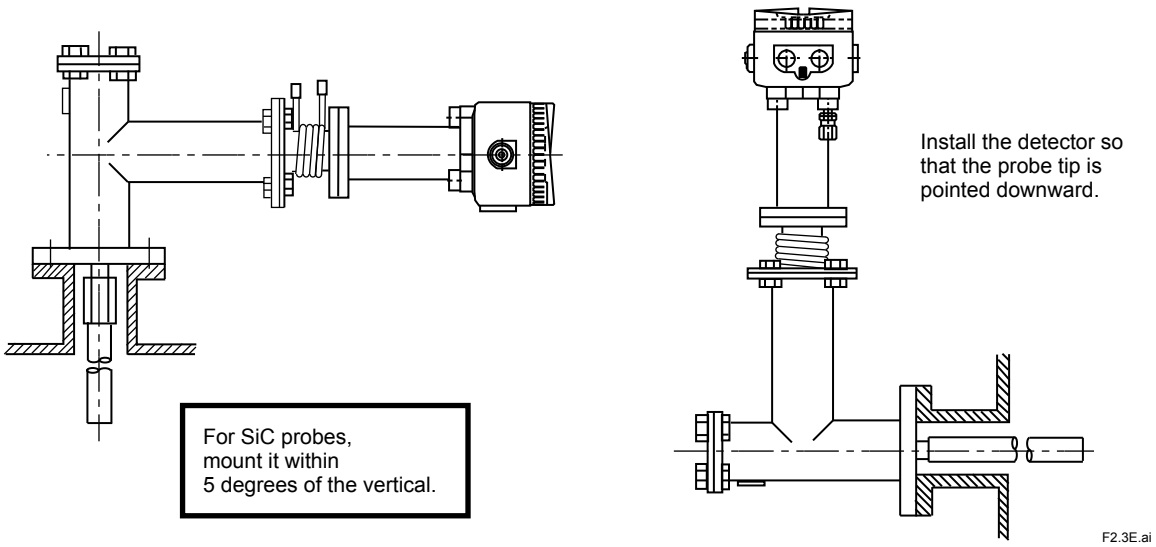


Figure 2.3 Installing the High-temperature Detector

2.2.4 Ejector Installation

For a high-temperature detector, two ejectors (main ejector: attached as standard; auxiliary ejector: optional) are required.

Only venting out of the furnace is applied for the measuring gas suctioned by the ejector in the case of a high-temperature probe adaptor.

(1) Ejector Installation

Install the main ejector for the detector and the high-temperature auxiliary ejector in the position shown in Figure 3.3. Both main and auxiliary ejectors can be installed in any direction at 90° angles. If soot accumulates on the bottom of the probe and corrodes it, it is recommended that the ejector be installed pointing downward for purging.

(2) Piping

CAUTION

The temperature of gas from outlet of ejector is high temperature (about 200°C).

Release it to safe place please.

It would arouse furns and furmiry accident.

a. Install the pressure gauges and supply the air adjusting the needle valves as near the ejector as possible. However, if the temperature of the pressure gauge mounting location exceeds 40°C, install them in a location at 40°C or less away from the ejector.

b. Use copper tubes or stainless steel tubes of OD 6 mm / ID 4 mm for piping. Take some measures such as winding the ejector's air supply tube around the detector itself (near the sensor) if the ambient temperature is low, so that the tube does not become clogged due to condensation by the cooled ejector (see Figure 2.5).

c. Ejector outlet piping:
For the detector with a high-temperature probe adaptor, the measuring gas cannot be returned to the furnace. Both the main ejector for the detector and the auxiliary ejector for the probe adaptor are influenced by back pressure, so do not connect any piping through the ejector outlet. However, to prevent rain water from entering the ejector, you can connect a 1/4-inch (10.5mm O.D.) pipe with a maximum length of 300 mm, bent slightly.

d. If there is positive pressure at the sampling point above 500 Pa and also release to the atmosphere is possible, main and auxiliary ejectors are not necessary. In this case, In this case, mount the needle valve on the auxiliary ejector mounting port and adjust it so that the temperature near the probe adaptor is 200°C. Also, directly connect a suitable needle valve which can adjust the vent gas quantity to the main ejector mounting port. Adjust the needle valve so that it will vent a gas quantity of 300 to 500 ml/min. This is because abnormal overheating of the detector cell section due to much sample gas exhaust should be prevented.

2.2.5 Heat Insulation

See section 2.3 “Heat Insulation.”

2.2.6 Blocking Radiant Heat

If the surface temperature of the flame arrester portion of the detector is likely to exceed 200°C due to heat radiating from the furnace wall or other heat sources, block the radiant heat with a blocking plate or take other measures.

2.3 Heat Insulation

CAUTION

For explosion protection standards, the lagging surface temperature must be kept to 200°C or less strictly.

To prevent the block by dew in the gas flowing pipe on probe, keep the temperature higher than dew-point.

2.3.1 Surface Temperature of Detector

The surface temperature of the detector must be kept below 200°C in accordance with the explosion protection standards. The ambient temperature significantly changes over the course of the year, and the operating condition changes as the load changes. Therefore, if factors that change the surface temperature change, be sure to check that the surface temperature is not above 200°C. If the surface temperature is above 200°C, reduce it to below 200°C by the methods described later (see section 2.3.3).

2.3.2 Portions Requiring Heat Insulation and Temperature to be Maintained

(1) Detector Sensor Portion’s Flame Arrestor

With regards to the heater for the frame arrestor, you can select either en electric heater or steam heater by specifying the model code.
The maximum controllable temperature of the electric heater is about 130°C. Accordingly, the electric heater can be used for gas burning or other applications for which the oxygen dew point is 130°C or less.

a. Heat Insulation by Electric Heater
Use heat insulating material to maintain the temperature of the frame arrestor portion above the dew point of the measuring gas.
Set the surface temperature of the electric heater to 160°C or less in order to prevent the thermal fuse built in the electric heater from meting down.

b. Heat Insulation by Steam Heater
Use a steam heater to heat the frame arrestor portion to maintain its temperature above the dew point of the measuring gas. Be sure to maintain the surface temperature of the steam heater below 200°C in accordance with the explosion protection standards.

(2) Detector's Main Ejector

Use a heater (electric or steam) to heat the main ejector to maintain its temperature above the dew point of the measuring gas. Be sure to maintain the surface temperature of the heater below 200°C in accordance with the explosion protection standards.
Wrap an ejector air pipe around the heater portion of the detector in order to prevent clogging in the ejector. (See Figure 2.5)

(3) Gas Suction Pipe of Detector Probe

As for general purpose detectors, use heat insulating material for the mating flange portion to maintain the temperature of the gas suction pipe of the detector probe above the dew point of the measuring gas. If necessary, use a steam heater, for example, to heat the gas suction pipe to maintain its temperature as specified.

(4) Probe Adapter

Maintain the heat of the probe adapter to keep its temperature above the dew point of the measuring gas. Although the probe adapter is not a flameproof instrument, be sure to maintain its surface temperature below 200°C when using it in combination with the flameproof detector. The surface temperature of the probe adapter should be measured on the surface of blind flange on the opposite side of the probe.

2.3.3 Methods to Change the Surface Temperature

If the surface temperature does not fall within the specified range, use the following methods to change the surface temperature so that it falls within the specified range.

<When the surface temperature exceeds 200°C>

(1) If insulating material is used, reduce the thickness of the insulating material, or remove it altogether. However, the surface temperature may fall below the dew point of the measuring gas in locations where raindrops fall on the surface or the surface is subjected to a strong wind. In such a case, provide a rain protection cover.

(2) Reduce the suction flowrate of the measuring gas of the probe adapter.

a. If the pressure in the furnace is negative, reduce the supply pressure to the ejector to reduce the suction flowrate of the measuring gas. For the setting of the suction flowrate, see section 6.1.8 "Supplying Pressure to Ejector."
If the suction flowrate is reduced, air is sucked from the ejector as a result of changes in the pressure in the furnace, resulting in an indication error. Be sure to check to make sure air is not sucked in.

b. If the pressure in the furnace is positive, reduce the aperture of the needle valve for the discharge outlet of measuring gas to reduce the suction amount of measuring gas. For the position of the needle valve, see section 5.1.2.

(3) If the surface temperature exceeds 200°C due to heat radiating from the furnace wall or other heat sources, provide a blocking plate or heat insulating material between the furnace wall and probe adapter and detector to block the radiant heat.

(4) If temperature rises significantly due to heat transfer, keep the mounting flange of the probe adapter and detector as far away as possible from the furnace wall.

<When the surface temperature falls below the dew point of measuring gas>

(1) If the probe adapter and detector are not thermally insulated, insulate them. (See section 2.3) If they are thermally insulated, enhance the thermal insulation effect by, for example, increasing the thickness of the heat insulating material. A thermal insulating jacket is available as an option to thermally insulate the detector and probe adapter. When installing the detector and probe adapter in locations where raindrops fall on their surface or their surface is subjected to a strong wind, the surface temperature is likely to fall below the dew point of the measuring gas, so be sure to provide a rain protection cover.
Keep the surface temperature of the electric heater below 160°C and that of the probe adapter below 200°C to prevent the thermal fuse built in the electric heater from melting down.

(2) Increase the suction amount of the probe adapter.

a. If the pressure in the furnace is negative, an increase in the supply pressure to the ejector increases the suction flowrate of measuring gas. For the setting of the suction flowrate, see section 6.1.8 “Supplying Pressure to Ejector.”
If there is a lot of dust, be careful, because an increase in the suction flowrate is likely to cause clogging in the ejector.

b. If the pressure in the furnace is positive, increasing the aperture of the needle valve for the discharge outlet of the measuring gas increases the suction amount of measuring gas. For the position of the needle valve, see section 5.1.2.

(3) If the above measures do not raise the surface temperature of the probe adapter, ejector, or mating flange above the dew point of measuring gas, heat them with heat sources such as a steam heater.

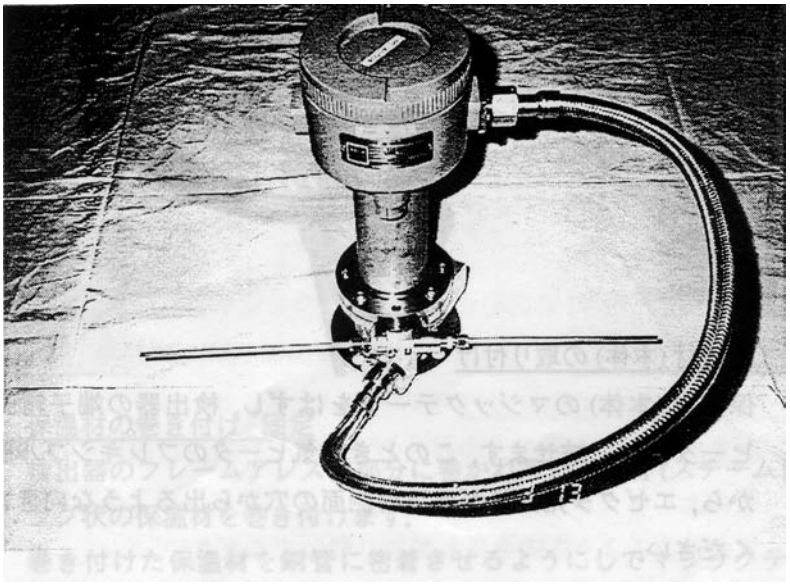
2.3.4 Fitting a Thermal Insulating Jacket (Option)

Note: Wrap the ejector air pipe around the heater portion of the detector. Be sure to insulate the exposed pipe and ejector air pipe that are not insulated by the thermal insulating jacket (option). Be sure to insulate the ejector outlet pipe, too.

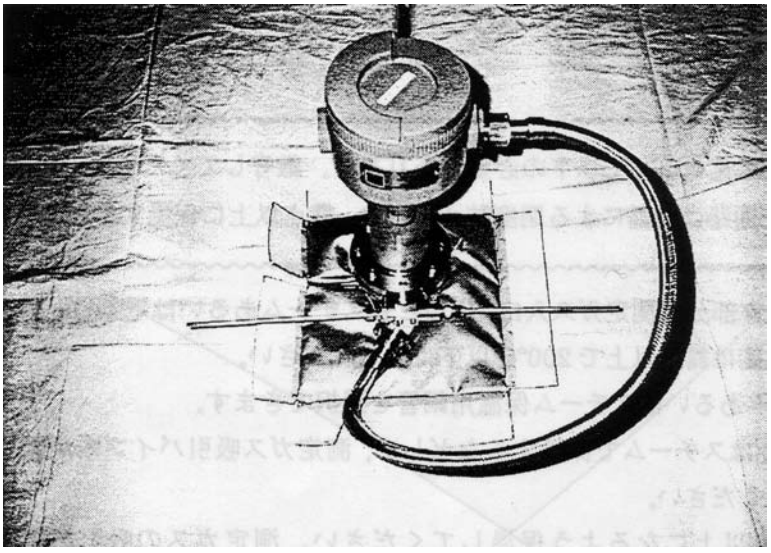
A. Heat insulation of detector

Please install the jacket as below:

- **In the case of electric heater**



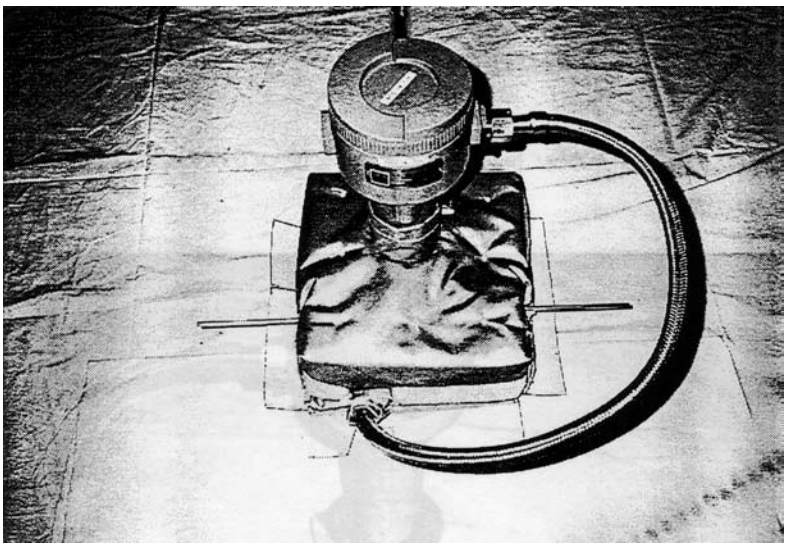
Procedure 1: Before install the jacket (Appearance)



Procedure 2: Fit the heat - insulate material (Plate)

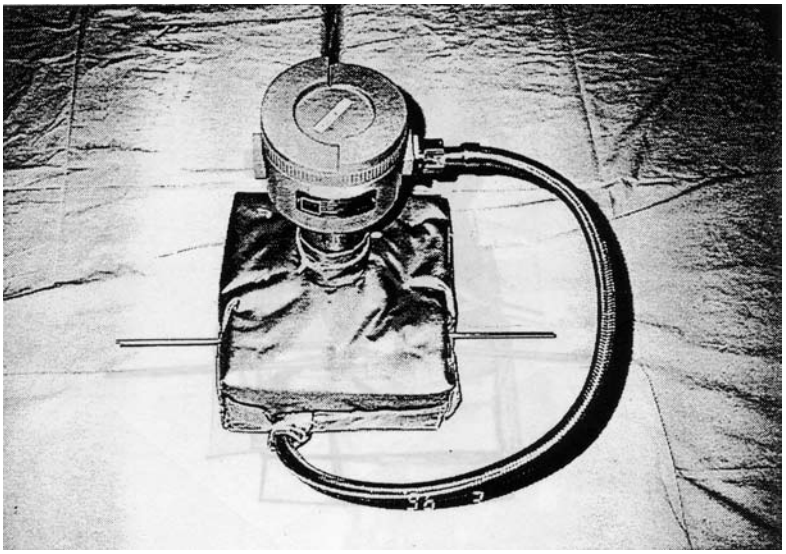
Make the flange side of detector probe on top (The side of electric heater for heat-insulation), undo the magic tape on plate heat-insulate material and let the magic tape on side face to the terminal box of detector, than insert it to the plate heat-insulate material.

Next. As photo above, stick the magic tape tightly.



Procedure 3: Fit the heat insulating material (Body)

Undo the magic tape on body heat insulate material, cover the heat-insulate electric heater from side of detector terminal box, and take care of : make flexible pipe from electronic hearter go through the surface of heat-insulate material ; make the pipe from ejector go out from the hole in two side of heat-insulate material.



Procedure 4: Fit the heat insulating material on the detector

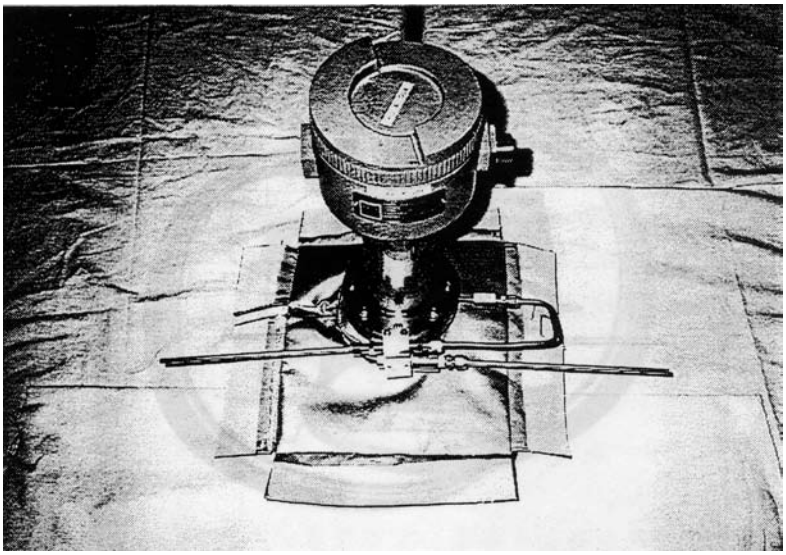
Stick the magic tape of plate heat insulate material on the side of heat insulate material (Body). And then stick the magic tape on the side of terminal box of heat-insulate material (Body) to the detector, wrap the flexible pipe up with magic tape on the side of plate heat insulate, stick it tightly and fix it by rope at last. These are all procedures. Please confirm your fitting by the photo above.

- **In the case of steam hearter**

Procedure 1: Wrap and fix the heat-insulate material

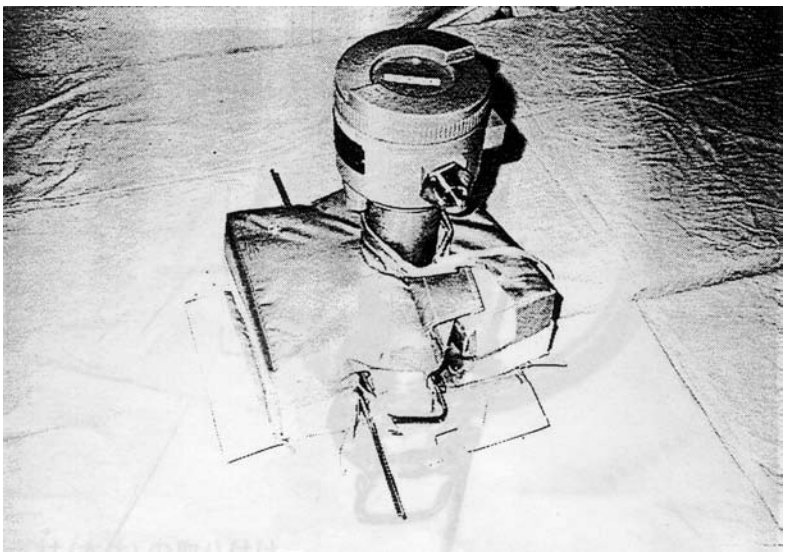
Wrap the copper pipe on the flame arrester of detector with ring-like heat-insulate material. Fix the ring-like heat-insulate on the copper pipe tightly by magic tape.

Please refer to photo by procedure 5 that the installation of jacket is finished.



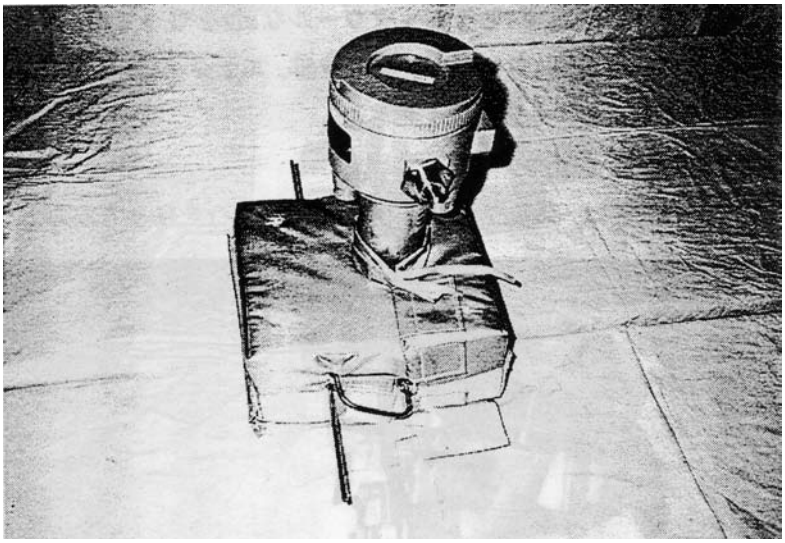
Procedure 2: Fit the heat insulating material (Plate)

Undo the magic tape on plate heat-insulate material, then insert it between the upside of flange of detector probe and pipe of outlet of steam pipe. At last close the inserting section tightly by magic tape.



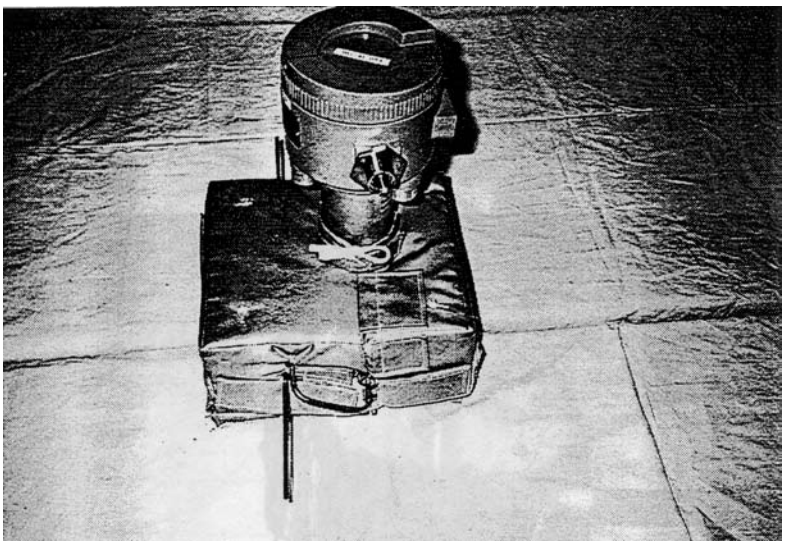
Procedure 3: Fit the heat insulating material (Body)

Undo the magic tape on body heat insulate material, cover the copper pipe of steam by heat-insulate electric material from side of detector terminal box.
Please take care of:
Make the pipe from ejector go out from the hole in two side of heat-insulate material.



Procedure 4: Fix the heat insulating material (Body)

Confirm that the pipe of ejector and pipe for heat-insulate steam go out from the heat-insulate material, stick the all magic tape of body.

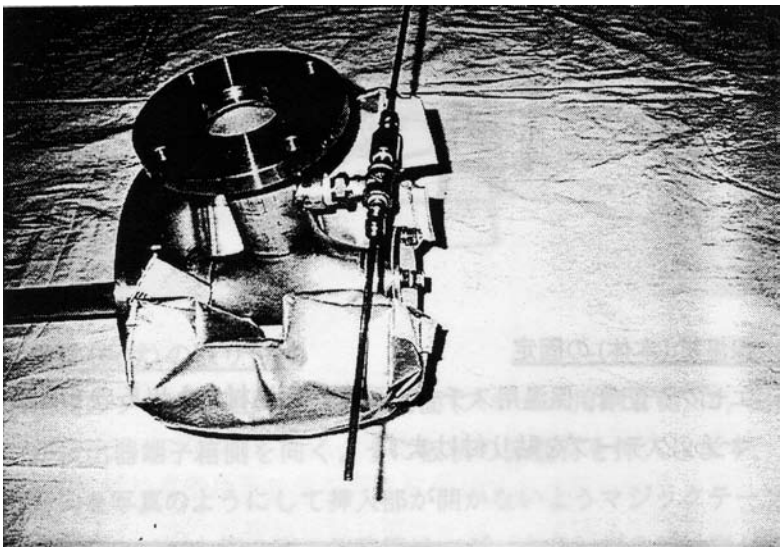


Procedure 5: Fix the heat insulating material on the detector
Stick the magic tape of plate heat insulate material on the side of heat insulate material (Body). And then wrap the detector up with magic tape of the side of terminal box, stick it tightly and fix it by rope at last.
These are all procedure.
Please confirm your fitting by the photo above.

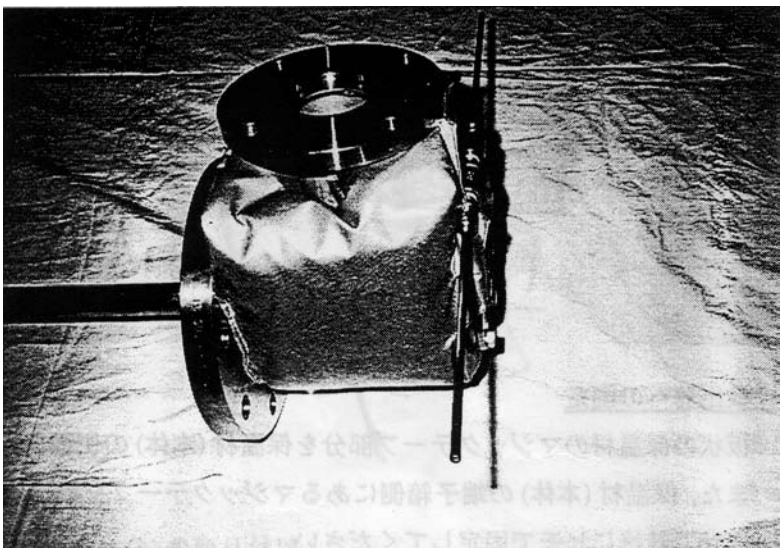
The heat-insulate effect would be weakened if heat-insulate section is got wet. Please set the waterproof on the heat-insulate section.
If the heat-insulate material (Ceramic wool etc.) is not used by jacket, please ensure fully in heat-insulate section (Flame arrester section and ejector section).
Please set the waterproof on the heat-insulate section also.

B. The heat-insulate in probe adapter

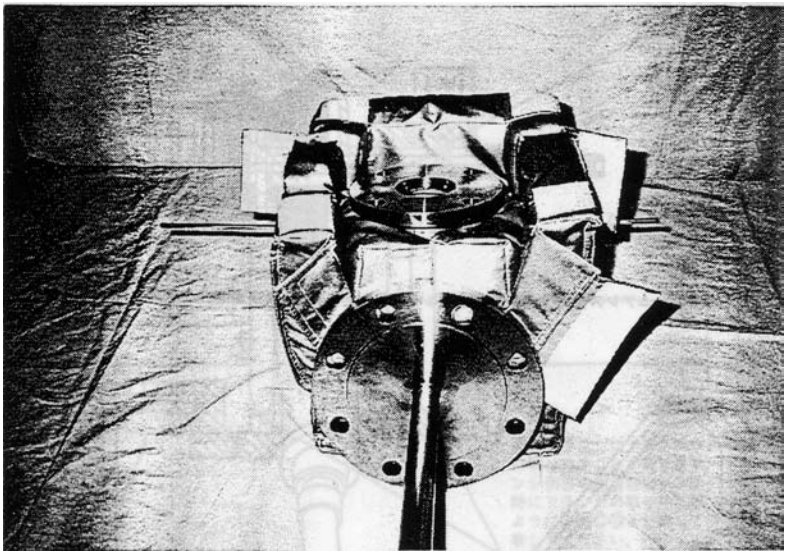
The heat-insulate in probe adapter is used by jacket as bellow:



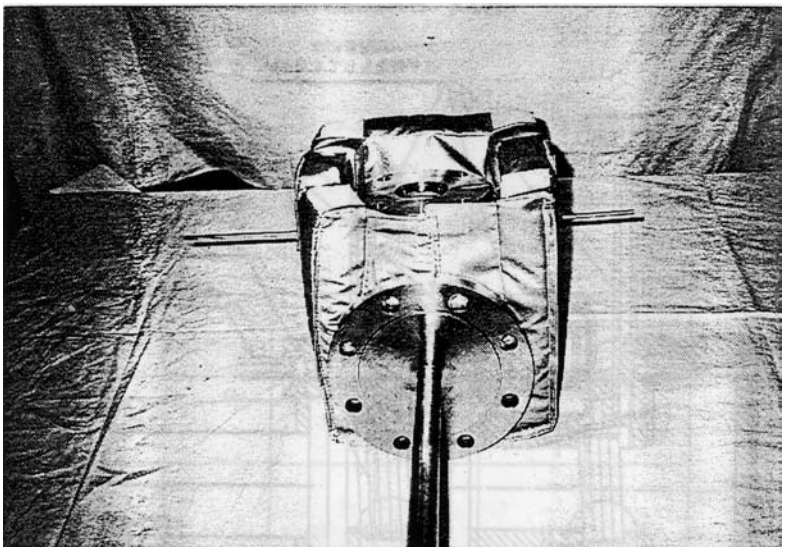
Procedure 1: Wrap the heat-insulate jacket (For inside).
Warp the frame adapter with inside heat-insulate jacket.



Procedure 2: Fix the heat-insulate jacket (For inside).
Wrap the Frame adapter tightly with wrapped jacket, and fix it by magic tape.
Please make the ejector out from the heat-insulate jacket.



Procedure 3: Fit the heat-insulate jacket (For outside)
Please undo the magic tape of outside heat-insulate jacket, make the mounting flange out from the jacket as photo above, then put the probe adapter (With inside heat-insulate jacket) in it. Make the pipe from ejector go out from the hole in two side of heat-insulate jacket.



Procedure 4: Fix the outside heat-insulate jacket

Finish the fitting of heat-insulate jacket by locking all the side magic tape.
Please confirm your fitting by the photo above.

If the condition temperature is below the dew point, please keep heat-insulate by steam or electric heater.
If the heat-insulate material (Ceramic wool etc.) is not used by jacket, please ensure fully in heat-insulate section (Flame arrester section and ejector section). Please set the waterproof on the heat-insulate section also.

2.3.5 Heating and Insulation Range when Not Using a Heat-Insulating Jacket

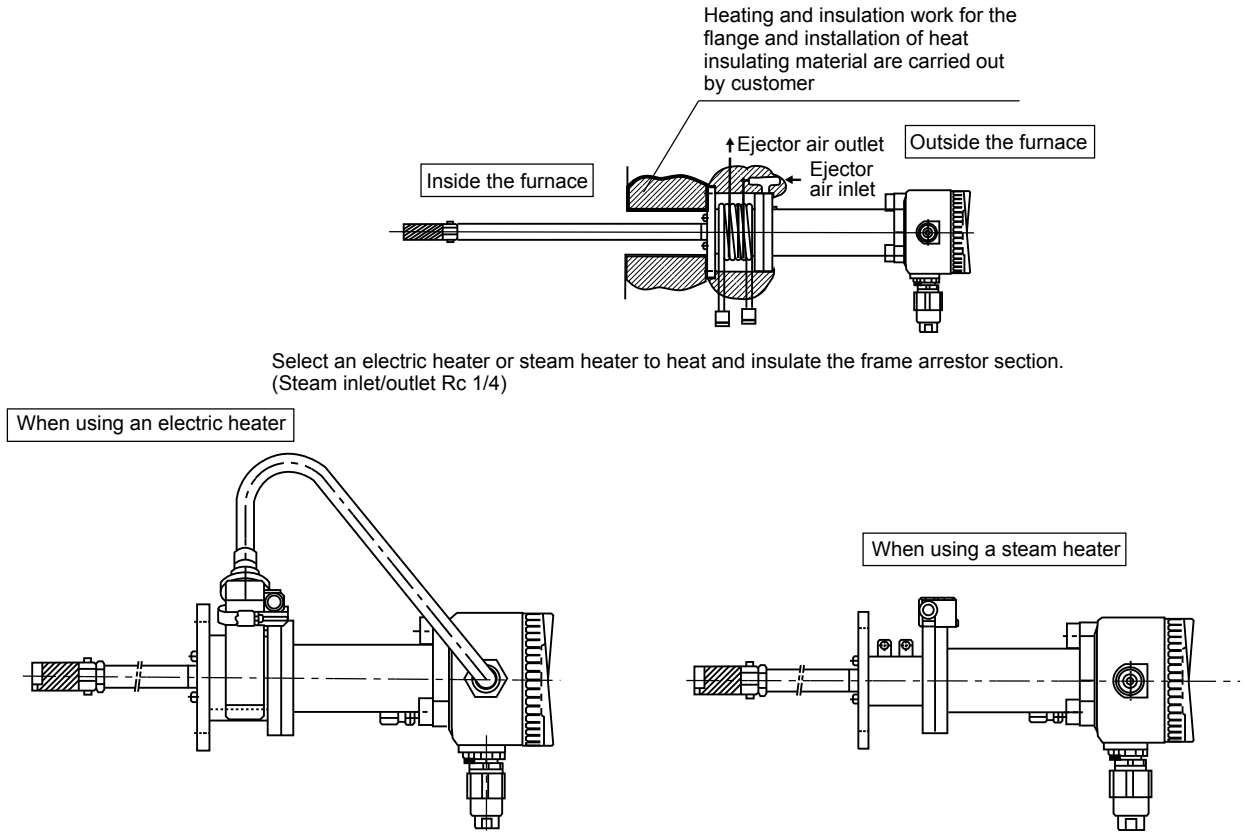

Heating and insulation work for the flange and installation of heat insulating material are carried out by customer
Ejector air outlet
Outside the furnace
Inside the furnace
Ejector air inlet
Select an electric heater or steam heater to heat and insulate the frame arrestor section.
(Steam inlet/outlet Rc 1/4)
When using an electric heater
When using a steam heater

Figure 2.4 Heating and Insulating Gas Flow Path Section

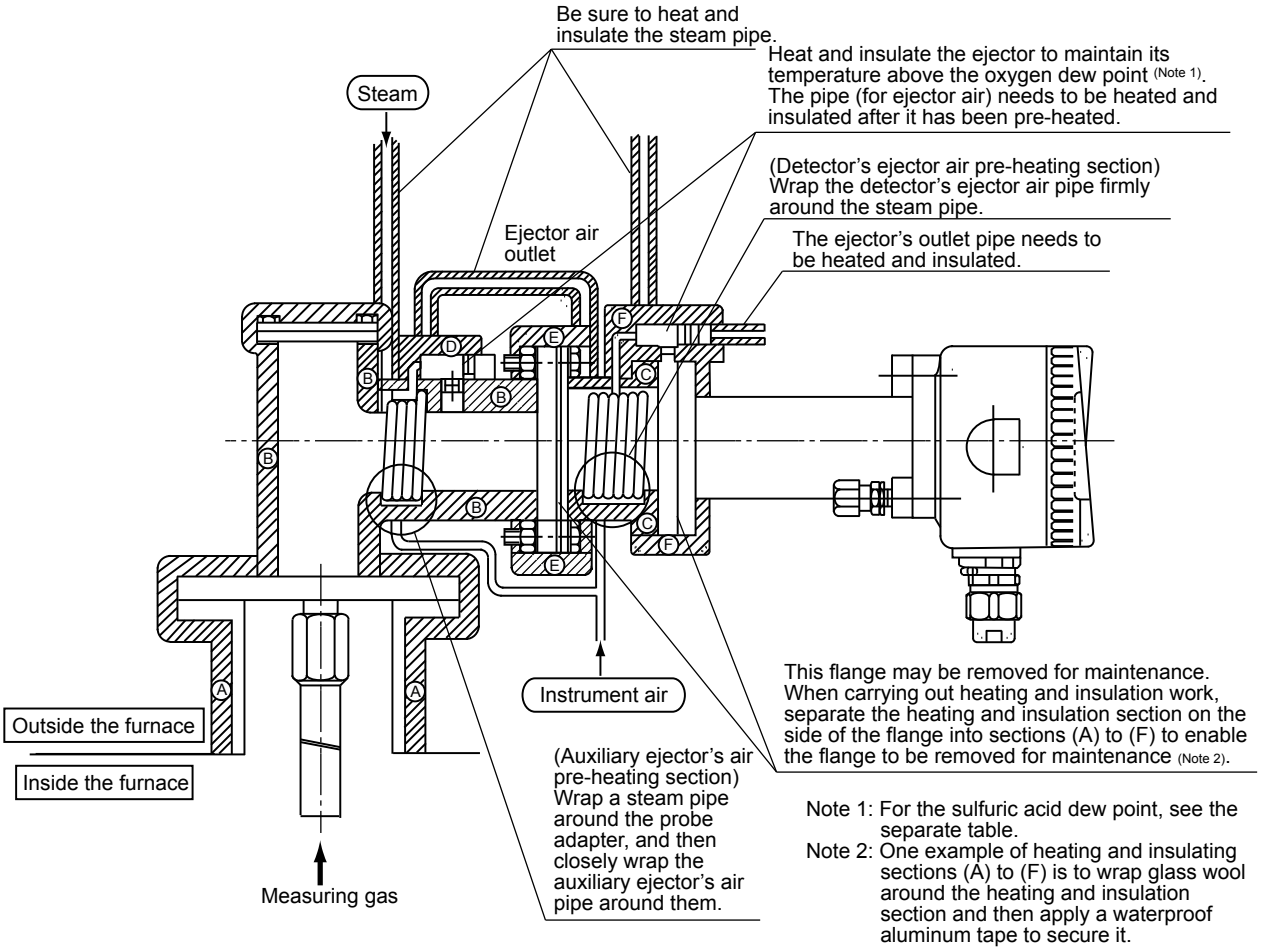

Be sure to heat and insulate the steam pipe.
Heat and insulate the ejector to maintain its temperature above the oxygen dew point (Note 1). The pipe (for ejector air) needs to be heated and insulated after it has been pre-heated.
Steam
(Detector's ejector air pre-heating section) Wrap the detector's ejector air pipe firmly around the steam pipe.
Ejector air outlet
The ejector's outlet pipe needs to be heated and insulated.
This flange may be removed for maintenance. When carrying out heating and insulation work, separate the heating and insulation section on the side of the flange into sections (A) to (F) to enable the flange to be removed for maintenance (Note 2).
Instrument air
Outside the furnace
Inside the furnace
(Auxiliary ejector's air pre-heating section) Wrap a steam pipe around the probe adapter, and then closely wrap the auxiliary ejector's air pipe around them.
Measuring gas
Note 1: For the sulfuric acid dew point, see the separate table.
Note 2: One example of heating and insulating sections (A) to (F) is to wrap glass wool around the heating and insulation section and then apply a waterproof aluminum tape to secure it.

Figure 2.5 Work Example of Heating and Insulating Flameproof High-Temperature Detector (Example of Heating and Insulation by Steam Heater)

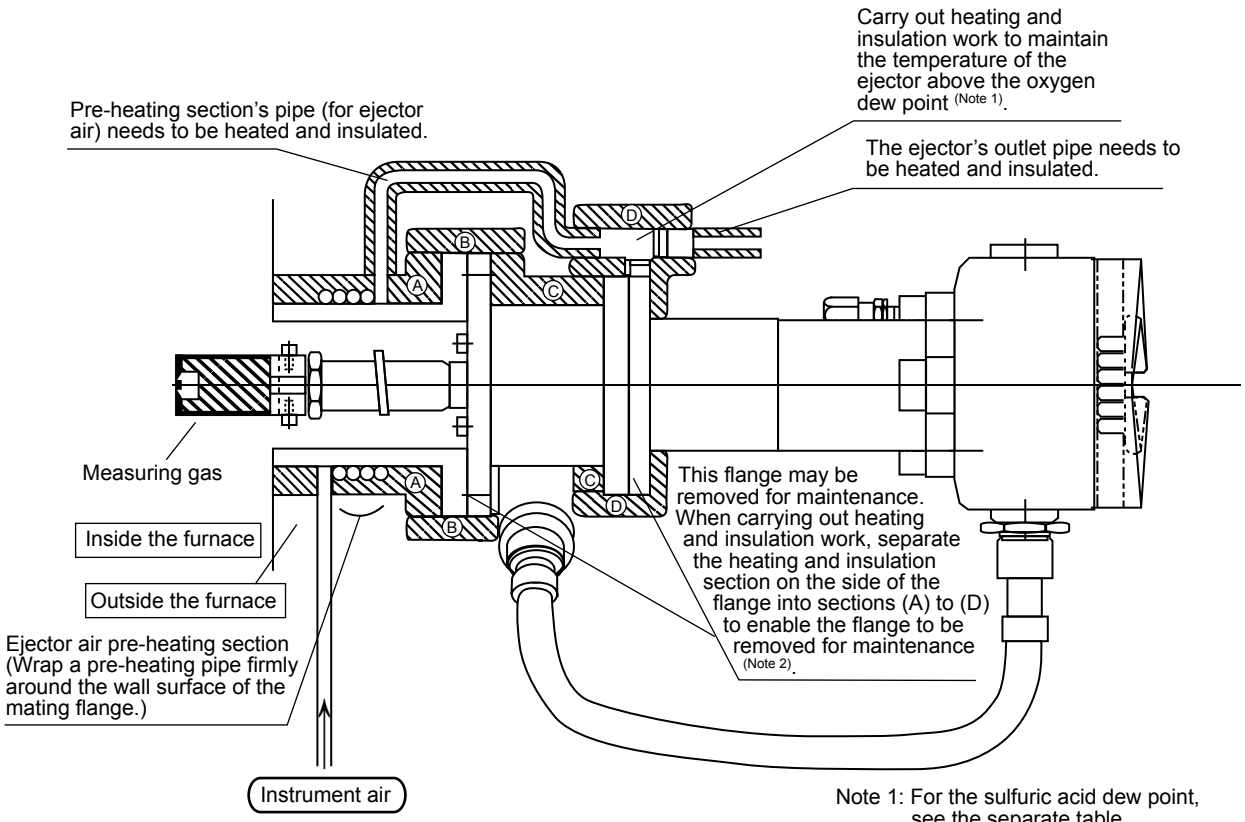
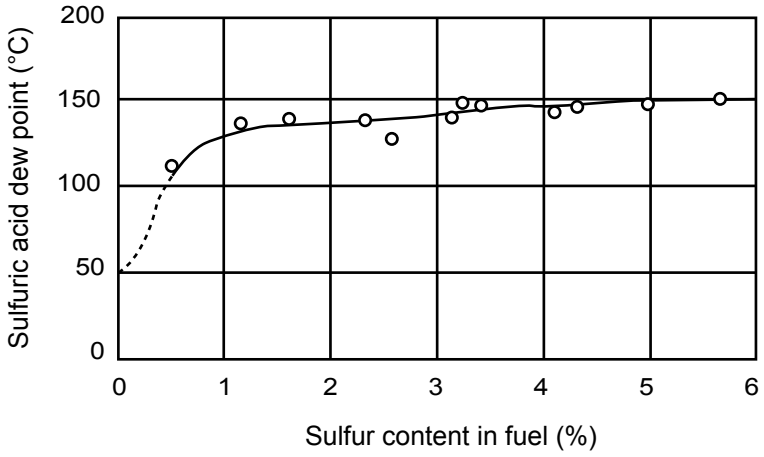

Carry out heating and insulation work to maintain the temperature of the ejector above the oxygen dew point (Note 1).
Pre-heating section's pipe (for ejector air) needs to be heated and insulated.
The ejector's outlet pipe needs to be heated and insulated.
A
B
C
D
Measuring gas
Inside the furnace
Outside the furnace
Ejector air pre-heating section (Wrap a pre-heating pipe firmly around the wall surface of the mating flange.)
This flange may be removed for maintenance. When carrying out heating and insulation work, separate the heating and insulation section on the side of the flange into sections (A) to (D) to enable the flange to be removed for maintenance (Note 2).
Instrument air
Note 1: For the sulfuric acid dew point, see the separate table.
Note 2: One example of heating and insulating sections (A) to (D) is to wrap glass wool around the heating and insulation section and then apply a waterproof aluminum tape to secure it.

Figure 2.6 Work Example of Heating and Insulating General-Purpose Flameproof Detector (Example of Heating and Insulation by Electric Heater)



Cited reference: L.K. Rendle and R.D.

Figure 2.7 Sulfur Content in Fuel and Sulfuric Acid Dew Point (for reference)

2.4 Installation of Converter

2.4.1 Installation Site

Install the converter by selecting a location where:

(1) the explosion protection standards are satisfied.

(2) the indicated oxygen concentrations and messages are legible and key operation is easy (avoiding exposure to direct sunlight),

(3) inspection and maintenance are easy,

(4) the ambient temperature is not too high (max. 55°C) and the temperature varies little (recommended to vary no more than 15°C a day),

(5) the humidity is moderate (40 to 75% RH is recommended) and no corrosive gases are present,

(Note) If there is a corrosive gas, carry out air purging. The air-purge tube joints are optionally attached only when required.

(6) there is little vibration,

(7) the detector is installed relatively nearby.

2.4.2 Converter Mounting

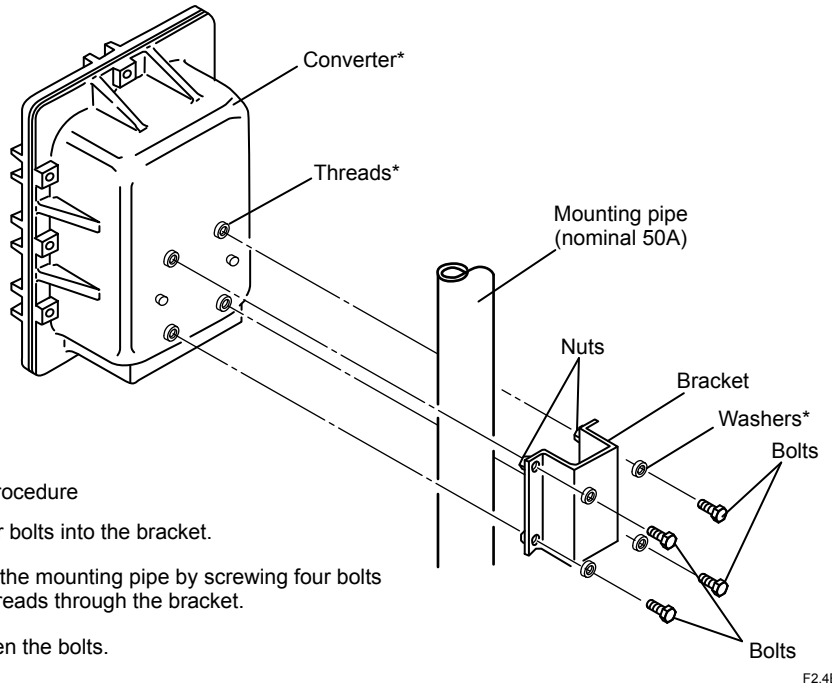
The converter can be mounted either to a pipe (nominal 50A) or on a wall. The converter can also be mounted at an angle, but as a rule, vertical mounting is recommended.

Carry out converter mounting in the following procedure:

Pipe Mounting

(1) Provide a pipe (nominal 50A, OD of 60.5 mm) for mounting the converter vertically with sufficient strength.

(2) Mount the converter to a pipe. Fix the converter rigidly in the procedure shown in Figure 2.9.



● Mounting Procedure

1. Screw four bolts into the bracket.
2. Sandwich the mounting pipe by screwing four bolts into the threads through the bracket.
3. Fully tighten the bolts.

Figure 2.9 Pipe Mounting

Wall Mounting

(1) Drill four mounting holes on the wall as shown in Figure 2.10.

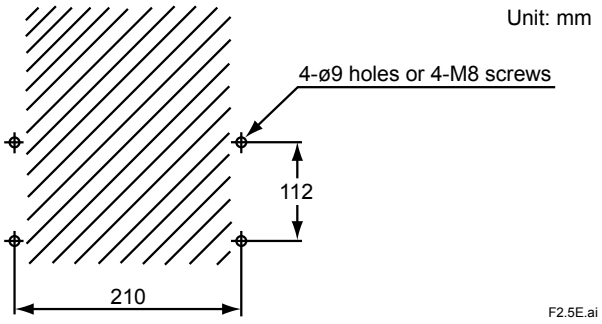


Figure 2.10 Machining of Mounting Holes

(2) Mount the converter. Securely fix the converter with four screws.
(Note) For wall mounting, install the wall mounting bracket on the back of the converter.

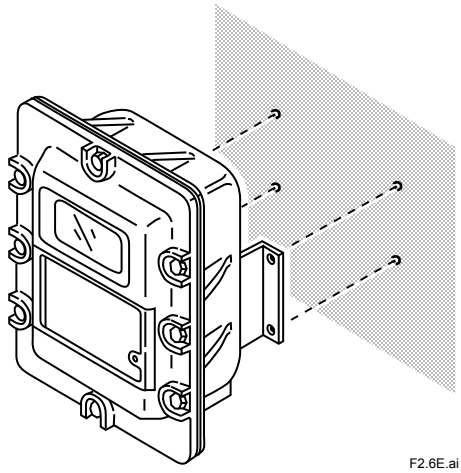


Figure 2.11 Wall Mounting

2.5 Installation of Flow Setting Unit

This is necessary when the ZA8F flow setting unit is to be used.

2.5.1 Installation Site

Install the flow setting unit by selecting a location where:

(1) there is access for inspection and maintenance,

(2) the locations of the detector and converter mounting are nearby,

(3) there are no corrosive gases,

(4) the ambient temperature is not too high (up to 55°C) and temperature fluctuations are small, and

(5) there is little vibration.

2.5.2 Flow Setting Unit Mounting

The flow setting unit can be mounted on a pipe (nominal 50A) or on the wall. As the flow setting unit incorporates a flowmeter, be sure to mount the unit vertically so that no error occurs. Mount the unit in the following procedure:

Pipe Mounting

(1) Provide a vertical mounting pipe (nominal 50A, OD of 60.5 mm) with sufficient strength.

(2) Mount the flow setting unit to the pipe. Securely fix the mounting bracket to the pipe by fully tightening the U-bolt nuts.

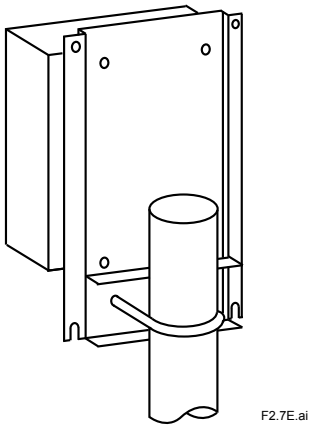


Figure 2.12 Pipe Mounting Status

Wall Mounting

(1) Drill the mounting holes to the wall as shown in Figure 2.12.

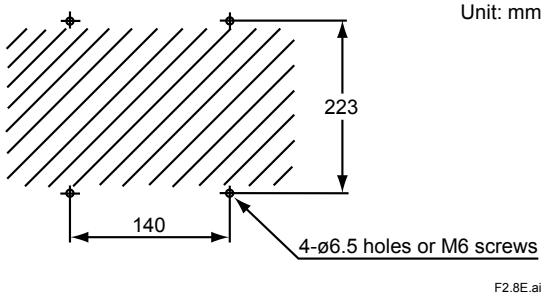


Figure 2.13 Drilling of Mounting Holes

(2) Mount the flow setting unit. Remove the pipe mounting parts from the mounting bracket and securely fix the unit to the wall.

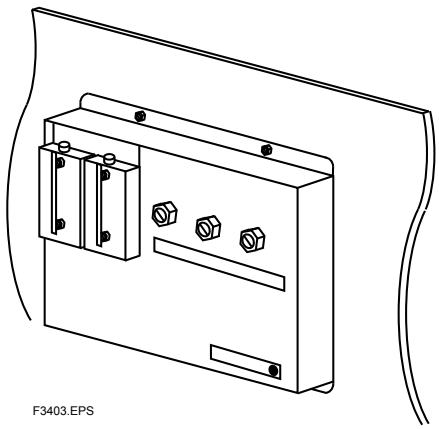


Figure 2.14 Wall Mounting Status

2.6 Installation of Calibration Gas Unit Case

The calibration gas unit case is a case for storing the G7001ZC zero-gas cylinder. The Installation procedure for the case when used is as follows:

2.6.1 Installation Site

Install the calibration gas unit case by selecting a location according to the following considerations:

(1) Convenience in replacement of the cylinder

(2) Easy access for inspection

(3) Proximity to the detector and converter as well as the flow setting unit

(4) Little vibration

(5) Ambient temperature of 40°C or less

2.6.2 Mounting

Mount the calibration gas unit case to a pipe (nominal 50A) in the following procedure:

(1) Provide a vertical mounting pipe (nominal 50A, OD of 60.5 mm) with sufficient strength.

(2) Mount the calibration gas unit case to the pipe. Securely fix the mounting bracket to the pipe by fully tightening the four U-bolt nuts.

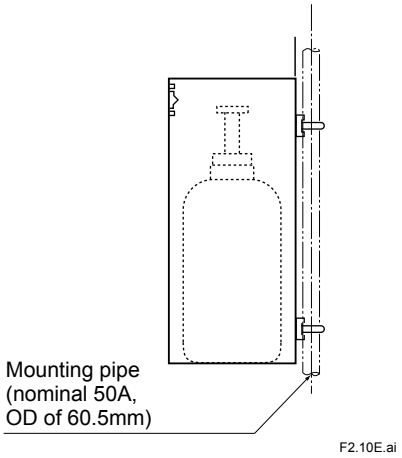


Figure 2.15 Pipe Mounting Status

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3. Piping

3.1 System

Piping is described for the system configuration shown in Figure 3.1.

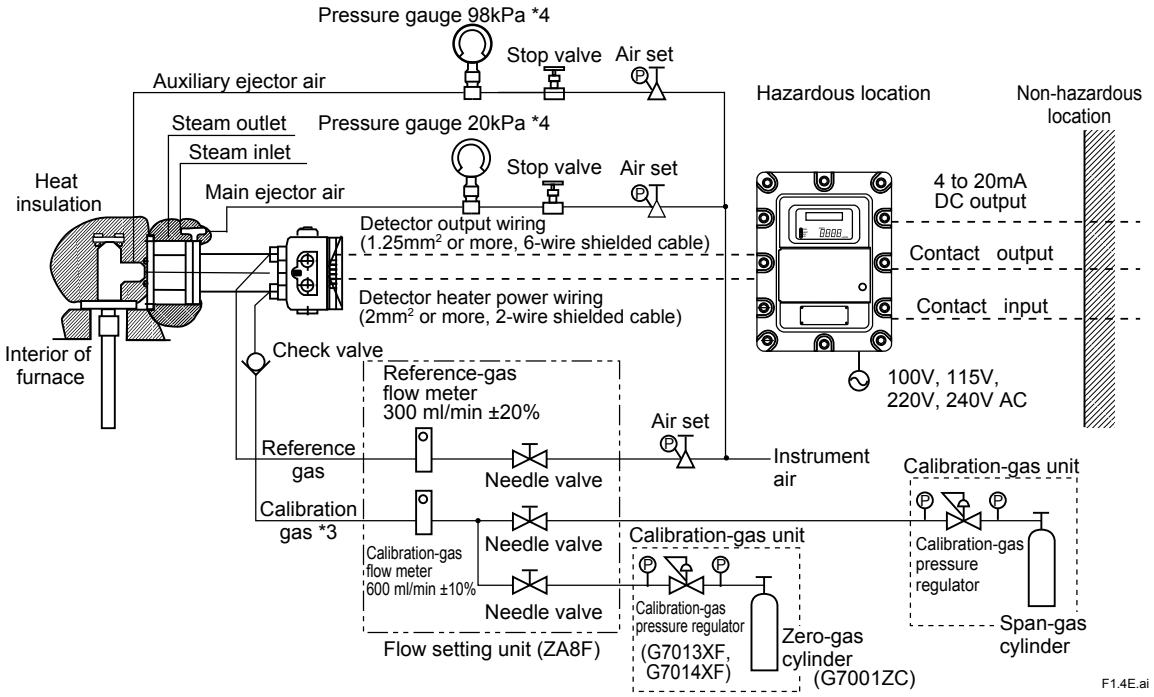


Figure 3.1 System Piping (for heat insulation by steam)

The main points of piping for this system are as follows:

- If the ambient temperature of the detector is 60°C or more, use heat-resistant pipes and joints. Also use instrument air (clean without dust, moisture, or oil mist).
- Mount a check valve to the calibration gas inlet of the detector. Connect the piping to the check valve.
- If a high-temperature detector for venting sample gas to the outside of the furnace is used and the pressure of the gas to be measured is 500 Pa or more, Install suitable restrictions like needle valves on the probe adaptor sample gas outlet and the main ejector gas outlet. In this case, set the amount of discharge from the needle valve to 300 to 500 ml/min.

  (Note) This is a measure taken to suppress the sample gas temperature to 800°C or less. If the measuring gas is high in temperature and also in pressure, the sample may reach the detector before its temperature decreases below 800°C. On the other hand, it is also not preferable for the condensate to be generated in the high-temperature probe adaptor because the sample gas temperature becomes too low. If condensate may be generated by a remarkable drop in the ambient temperature in winter, protect the high-temperature probe adaptor with lagging.

- Use copper or stainless steel pipes (OD of about 6 mm / ID of 4 mm) for the piping. However, use stainless steel pipes if the piping is in a location where the ambient temperature exceeds 60°C or a corrosive atmosphere exists.

3.2 Parts Required for Piping

Check that the parts listed in Table 3.1 are ready.

Table 3.1 Major Parts for Piping

Detector used	Type of piping	Parts required	Description	
Flameproof detector	Calibration gas piping	Check valve	Item recommended by Yokogawa (K9292DN or K9292DS)	
		• Nipple	Rc1/4 or 1/4NPT	On the market
		Zero-gas cylinder	Item recommended by Yokogawa (G7001ZC)	
		Pressure regulator	Item recommended by Yokogawa (G7013XF or G7014XF)	
		Piping joint	Rc1/4 or 1/4NPT	On the market
	Reference gas piping	Air set	Item recommended by Yokogawa (G7003XF or K9473XK)	
		Piping joint	Rc1/4 or 1/4NPT	On the market
Flameproof high-temperature detector	Calibration gas piping	Check valve	Item recommended by Yokogawa (E7042VR or E7042VV)	
		• Nipple	Rc1/4 or 1/4NPT	On the market
		Zero-gas cylinder	Item recommended by Yokogawa (G7001ZC)	
		Pressure regulator	Item recommended by Yokogawa (G7013XF or G7014XF)	
		Piping joint	Rc1/4 or 1/4NPT	On the market
	Reference gas piping	Air set	Item recommended by Yokogawa (G7003XF or K9473XK)	
		Piping joint	Rc1/4 or 1/4NPT	On the market
	Sample gas suction piping	• Auxiliary ejector	Item recommended by Yokogawa (K9292WA or K9292WB)	
		• Regular tee, piping joint	Rc1/4 or 1/4NPT	On the market
		• Needle valve	Rc1/4 or 1/4NPT	On the market
		• Different diameter nipple	Rc1/2 - Rc1/4, Rc1/2 - 1/4NPT	On the market

The parts marked • should be used if necessary.

3.3 Calibration Gas Piping

This piping should be provided between the zero-gas cylinder and the flow setting unit and between the flow setting unit and the detector. Install the cylinder where it is exposed to direct sunlight as little as possible, e.g., accommodated in the calibration gas unit case. Also mount the pressure regulator for the cylinder (recommended by Yokogawa) to the cylinder.

Attach a check valve to the calibration gas inlet of the detector as shown in Figure 3.2 (the detector is shipped with the check valve attached). Use a stainless steel pipe with an OD of 6 mm/ID of 4 mm (or nominal 1/4-inch) for the piping between the flow setting unit and the detector.

Unit: mm

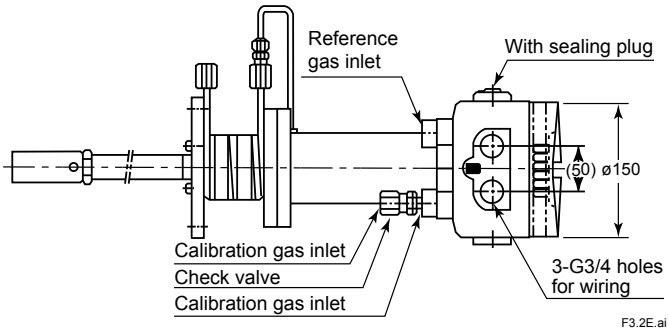


Figure 3.2 Connection of Check Valve to the Calibration Gas Inlet

3.4 Reference Gas Piping

- The reference gas piping is provided between the air supply (instrument air) and the flow setting unit and between the flow setting unit and the detector.
- In the piping between the air supply and the flow setting unit, insert an air set close to the flow setting unit. Prepare a flowmeter and a control valve for reference air so that the specified flowrate of 300ml/min ± 20% can normally be obtained.
- Use a stainless steel pipe with an OD of 6 mm/ID of 4 mm (or nominal 1/4-inch) for the piping between the flow setting unit and the detector.
- Piping to the reference air outlet is not necessary (refer to Section 2.1.4).

3.5 Piping to Probe Adaptor

If the measuring gas pressure is negative, the gas must be forcibly suctioned. Connect the piping parts for this purpose to the probe adaptor when the high temperature detector is used.

Connect an auxiliary ejector in the procedure shown in Figure 3.3 when the measuring gas pressure is negative. Mount the pressure gauge as near the auxiliary ejector as possible. However, if the ambient temperature is high, place the piping in a location at 40°C or less.

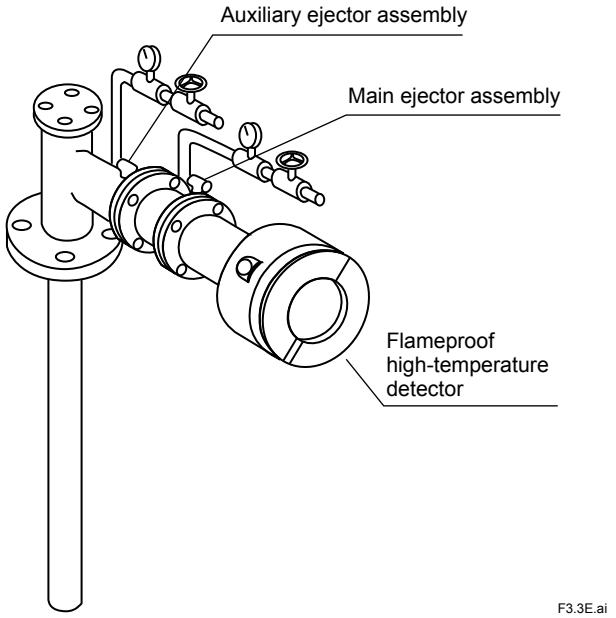


Figure 3.3 Connection of Ejector

3.6 Purge Gas Piping

If there are corrosive gases in the atmosphere, or if the ambient temperature at the converter-installed location is high, purge the inside of the converter with air. Connect a copper or stainless steel pipe to the purge air inlet. Set the supply air to about 50 kPa. If purging is to be carried out, remove the gasket between the cable gland and the converter in one port to make an outlet for the purge air.

Unit: mm

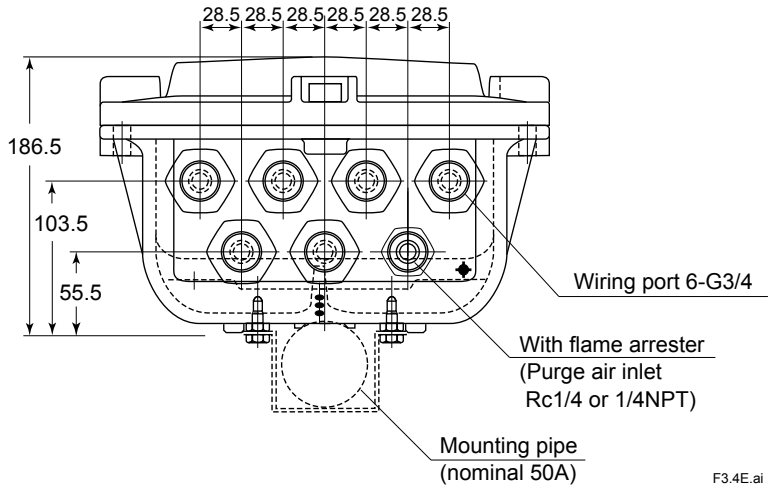


Figure 3.4 Converter Purging

3.6.1 Piping for Air Purge in Converter

If specified, the air purge joint is already connected to the bottom of the converter upon shipment. Make piping using a copper tube or the like with an OD of 6 mm / ID of 4 mm (or nominal size 1/4-inch) between the air supply and the air purge joint.

3.6.2 Air Supply for Air Purging

Implement air purging using clean dry air. For example, use instrument air as the air supply. Air consumption is about 1 l/min when the supply air pressure is 50 kPa.

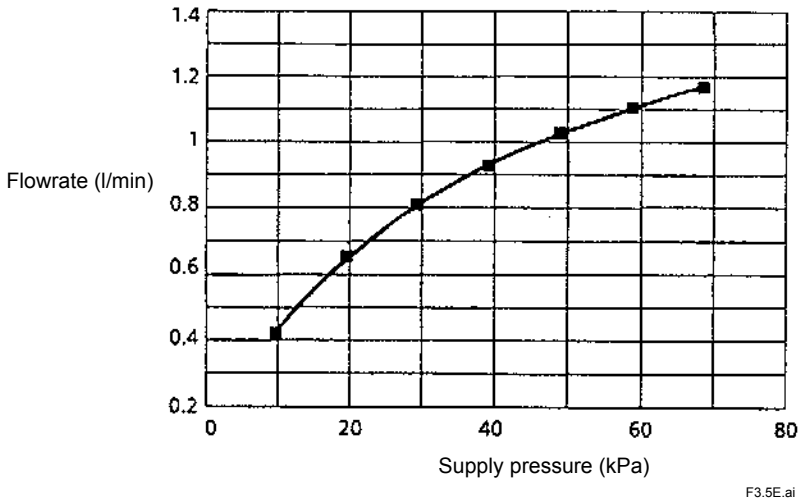


Figure 3.5 Flow Characteristics of Joint on Air Supply Side

4. Wiring

This chapter describes procedures for wiring to be provided for the Model ZS8C Flameproof Converter.

WARNING

(1) Never turn on the power before wiring work is completed, construction work conforming to the explosion protection standards is over, and the converter cover is mounted. Otherwise, there is the danger of ignition or an explosion depending on the atmosphere around the instrument.

(2) There is the danger of electrical shock if the terminals are touched.

4.1 Safety Precaution for External Wiring

CAUTION

For external wiring, always use the specified external cable lead-in utensils.

Otherwise, the wiring may not conform to the explosion protection standards and may introduce the danger of an explosion by the ignition of gases around the equipment and units.

4.1.1 Wiring Precautions

For external wiring, use cables for flameproof packing use.
Determine each conductor's diameter in the cables between the detector and the converter so that the conductor resistance including that of returning wire is 10Ω or less. Securely ground dead exposed metal parts (conforming to JIS class 3 grounding [grounding resistance of 100Ω or less]). For details, see USERS' GUIDELINES for Electrical Installation for Explosive Gas Atmospheres in General Industry, issued by the Research Institute of Industrial Safety of the Ministry of Labor in Japan, 1994.

Generally carry out wiring work taking care with the following points:

1. Do the electrical wiring so as to avoid laying the cable together with the power cables for large capacity transformers, motors or other power supplying cables.
2. Be sure to apply waterproof treatment for screws (it is recommended for waterproof treatment that silicone resin group non-curing sealing agents be used).
3. Do not use the same duct for the signal cables and power cables in order to prevent noise. Also, use shielded cables when wiring is carried out where wiring is likely to be affected by noise.
4. If wiring is to be carried out in a location where the ambient temperature is high or low, use wires or cables matching the location.
5. If the analyzer is to be used in an atmosphere containing harmful gases or liquids, or oil or solvents, use wires or cables that use a material resistant to these.
6. It is recommended that the end of wires used for wiring in the converter be end-treated using crimp-on terminal lugs with an insulation sleeve (for M4 screw).

7. If the ambient temperature of the detector-installed location exceeds 60°C, do not use crimp-on terminal lugs with an insulation sleeve or insulation tape. This may cause poor contact at the terminals because resin is parched at high temperatures and toxic gases are generated. It is recommended that nickel-plated bare crimp-on terminal lugs be used in high-temperature locations (detector terminal board screws are for M3.5 and M4 screws).

4.1.2 Care During Wiring

(1) Turn off all power supplies and make wiring by removing the detector and converter covers. Among the bolts for mounting the converter cover, the one on the bottom left is longer than the others. In ordinary maintenance, remove all other bolts except this bolt and carry out work rotating the cover around this bolt. This may prevent an accident from dropping the cover.

(2) Terminal arrangements for the detector and the converter are as shown in Figures 4.1 and 4.2. Perform terminal connections based on the connection diagram of Figure 4.11.

(3) Use wires by selecting sheath materials depending on the ambient temperature near the wiring path to the detector. Also determine wire size (diameter) for wiring between the detector and converter so that the conductor resistance including that of the return wire is 10Ω or less. When a multi-conductor cable is to be used, select that with a finished OD matching the electric wire lead-in utensils used. (This is described in section 4.2, “Wiring for Detector Signal,” and later.)

(4) For installation where the ambient temperature exceeds 80°C, be sure to use heat-resistant covering wires for wiring. In addition, also use a heat-resistant flexible conduit between the detector and relaying connection box or between conduits, and in particular, consider rainproofness in the case of outdoor installation.

(5) Be sure to connect wire ends to predetermined terminals using crimp-on terminal lugs.

(Note) If the ambient temperature of the location where the detector is installed exceeds 60°C, do not use terminal lugs with an insulation sleeve or insulation resin tape. The use of these may cause a poor contact of the terminals due to toxic gas produced through burning of the resin. In high-temperature locations, it is recommended that nickel-plated bare crimp-on terminals be used (for detector terminal board M3.5 or M4 screws).

(6) Use of conduit is recommended for wiring.
Both the detector and the converter have wiring holes of G3/4. Connect cables using the specified cable glands. In addition, in wiring work around the detector, use flexible conduits so that the detector probe can be pulled out without disconnecting the wiring between the detector and the relaying terminal box or between the conduits.

(7) Exercise care so that noise does not mix into the signal wires.

a. Separate the signal cable from the power cable and ground wire. Thus, if wiring to the detector and converter is to use conduits, pass the signal cable and the heater cable through separate conduits.

b. Use a shielded cable for the signal cable. Connect the shield to the screw with the ground mark (⏚) of the detector. In this case, exercise care so that the shield does not touch the heater terminals. Leave the shield unconnected in the converter.

c. The heater cable may use a two-conductor cable without shield if it is wired through a conduit separate from the signal cable.

Unit: mm

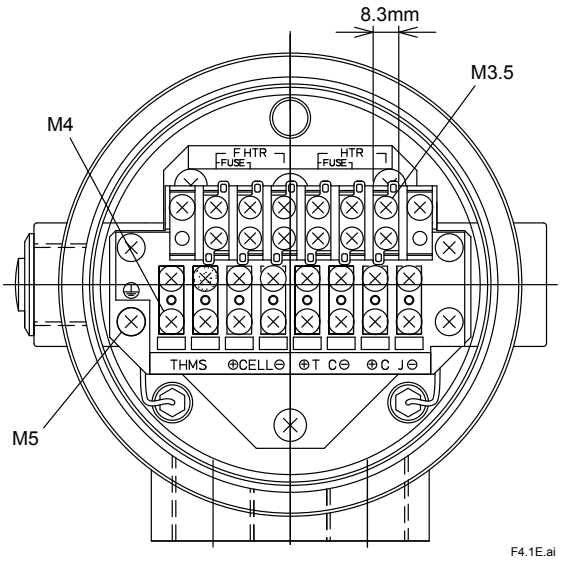


Figure 4.1 Detector Terminal Arrangement

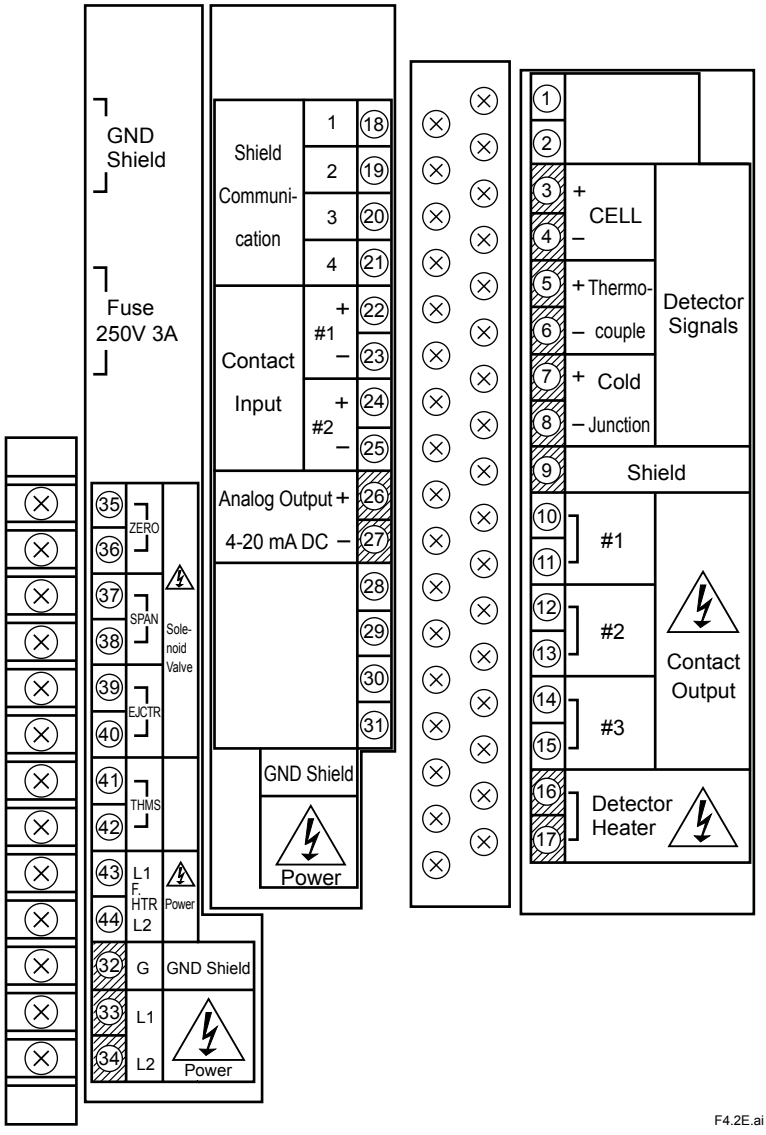


Figure 4.2 Converter Terminal Arrangement

4.1.3 Cables

- Use a CVV PVC-insulated and -sheathed control cable (JIS C3401) and others for the cables and lay it, if necessary, in steel conduits to protect it from external damage. For screw parts, be sure to coat non-curing seal materials and also apply a waterproof treatment.
- For wiring a cable with the lead-in procedure using flameproof packing, be sure to use the external cable lead-in utensils specified by Yokogawa. Part numbers in Yokogawa for these external cable lead-in utensils are as shown below depending on conduit connection screw size.

Table 4.1 External Cable Lead-in Utensils

Name	Part name	Specifications	Description
CABLE GLAND	G9601AE	Cable with OD of 10 to 13.5 mm	Cable gland screw G3/4 on the conduit side

- As the cable to be used, select a cable with an OD matching the wire lead-in utensils to be used and select packing with an ID closest to the cable's OD.

Table 4.2 Recommended Cables

Type of wiring	Type of cables		Wire cross section	Conditions
	Construction	Material		
Detector signal output	For steam heaters: 6-conductor shielded wire For electric heaters: 8-conductor shielded wire	CVVS	1.25 mm^2 or more	10 ohm or less
Detector heater power	For steam heaters: 2-conductor shielded wire For electric heaters: 4-conductor shielded wire	CVVS	2.0 mm^2 or more	3 ohm or less
Power supply	2- or 3-conductor wire (one conductor is to be grounded)	CVV	2.0 mm^2 or more	
Analog output signal	2-conductor shielded wire	CVVS	0.5 mm^2 or more	
Digital communication signal	3-pair twisted-pair shielded wire or 6-conductor shielded wire	CVVS	0.3 mm^2 or more	
Contact output	2- or 4-conductor (shielded) wire	CVV	0.75 mm^2 or more	
Solenoid valve driving power	4-conductor (shielded) wire	CVV	0.75 mm^2 or more	
Contact input	2- or 4-conductor (shielded) wire	CVV	0.75 mm^2 or more	
Grounding		CVV	1.6 mm^2 or more	100 ohm or less

If the ambient temperature is 60°C or more, use heat-resistant wires.

4.1.4 Mounting of Cable Gland

Mount a specified cable gland (external wire lead-in utensil) in a converter cable inlet port except for implementation of conduit work.

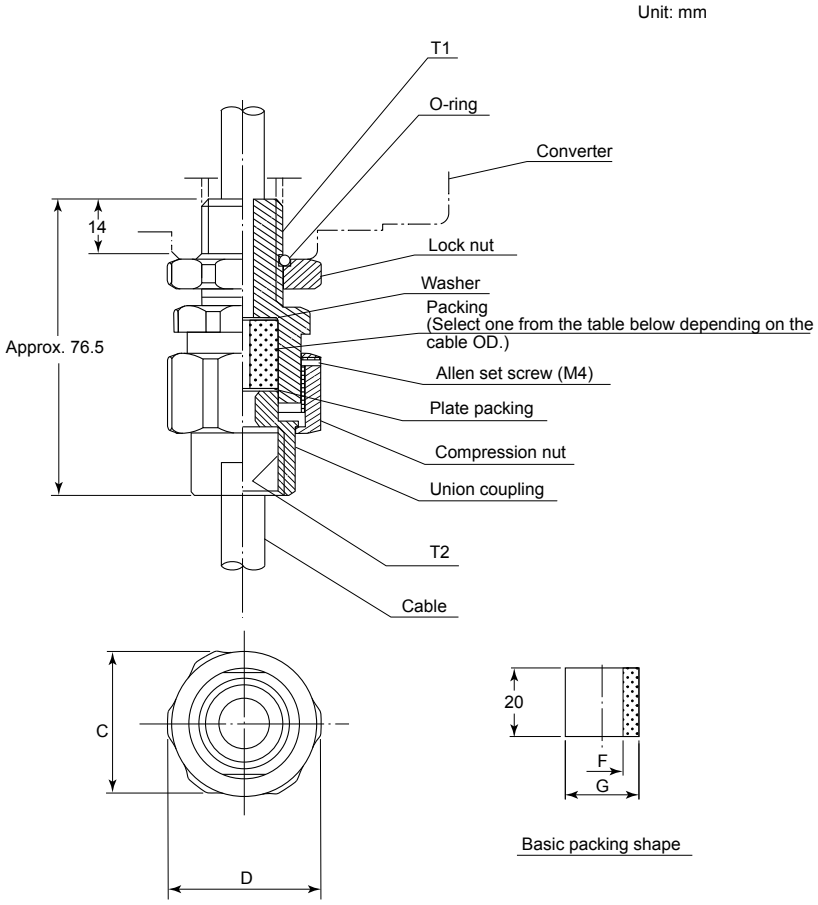


Table 4.3 Cable Gland Dimensions

	Cable gland dimensions				Cable OD (actual measured value)	Packing		Identification mark
	Connection screw thread		Hexagon part					
	Size		Width across flats	Width across corners				
	Tl	T2				F	G	
	G(PF)	G(PF)	mm	mm		mm	mm	
G9601AE	3/4	3/4	41.0	44.0	Ø10 to Ø11	Ø11	Ø24	11Ø
					Ø11.1 to Ø12	Ø12		12Ø
					Ø12.1 to Ø13.5	Ø13.5		13.5Ø

4.2 Wiring for Detector Signal

This wiring is made so that the converter receives the cell output, thermocouple output, and cold junction compensating signal from the detector. Lay the wiring cable so that each signal wire resistance including each return wire is 10Ω or less. Also lay the cable away from the power cables.

- **In the case of steam heater**

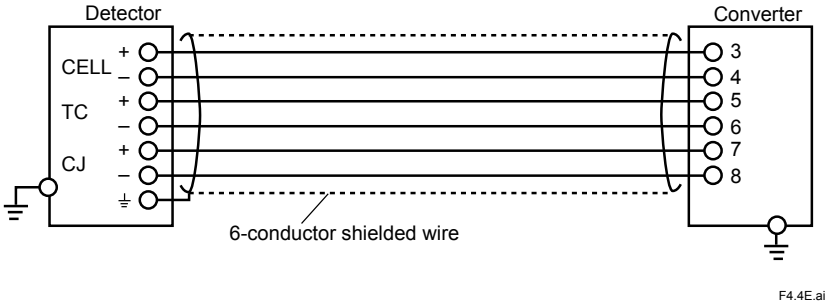


Figure 4.3 Wiring for Detector Signal (In the case of steam heater)

- **In the case of electric heater**

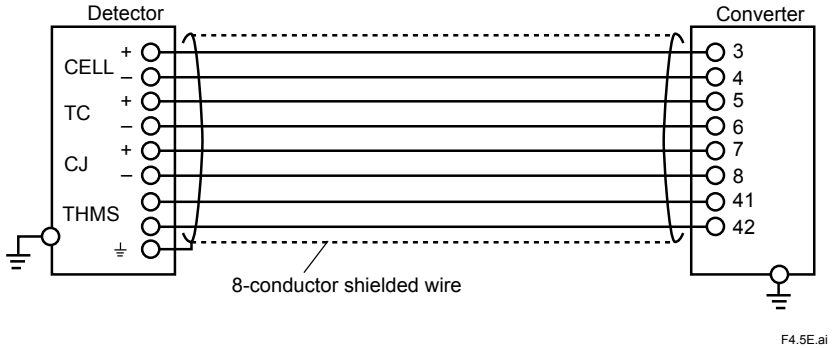


Figure 4.4 Wiring for Detector Signal (In the case of electric heater)

4.2.1 Cable Specifications

Use a shielded cable of 10 to 13.5 mm OD for this wiring as a rule. For details, see Table 4.1, “Recommended Cables.”

4.2.2 Connection to Detector

Connect the cable to the detector taking the following into account:

(1) The cable inlet port of the detector is a hole G3/4 mm in diameter. Use the specified electric wire lead-in utensils. As the detector may be removed for maintenance, allow a sufficient margin for the cable length.

(2) Connect the cable shield to the ground terminal.

(Note) The cable shield is grounded on the converter side if 600-V grade silicone rubber insulated glass-fiber braided wires are used.

4.2.3 Connection to Converter

Connect the cable to the converter taking the following into account:

(1) The terminal screws of the converter are of M4 type (ISO 4 mm). Treat the cable end using crimp-on type terminal lugs conforming to this screw size.

(2) Avoid double connection to the converter of a ground wire already connected to the detector. For grounding, see also Section 4.5.

4.3 Wiring for Detector Heater Power

4.3.1 Wiring for Sensor Heater Power (In the case of steam heater)

This wiring is for supplying power to the heater to heat the sensor in the detector from the converter.

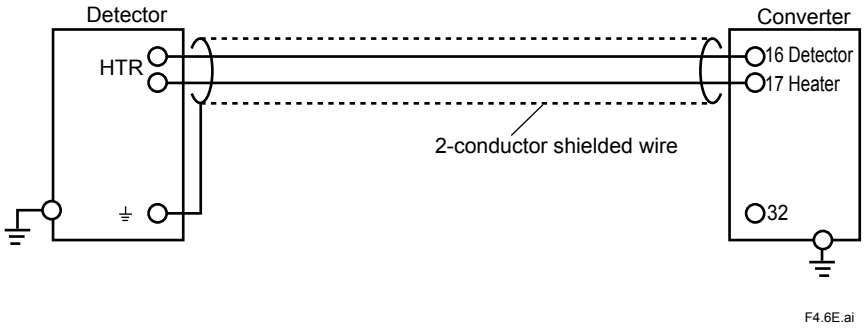


Figure 4.5 Wiring for Detector Heater Power

4.3.2 Wiring for Detector Heater Power (In the case of electric heater)

This wiring is for supplying power to the heater for detector heat insulation above the dew point.

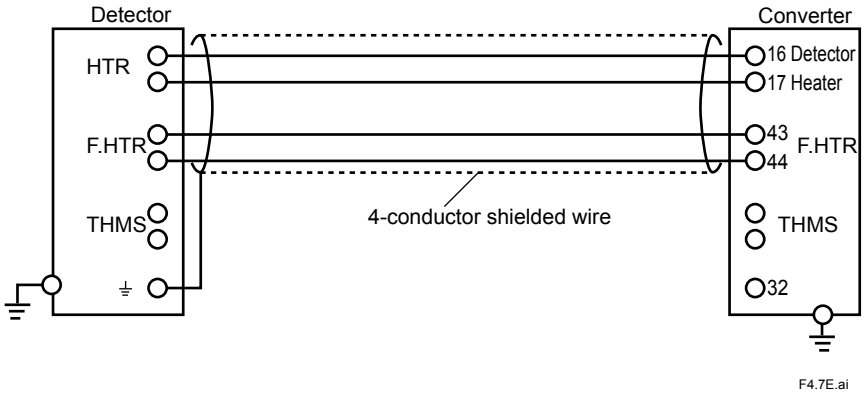


Figure 4.6 Heater Power Supply Wiring for Detector Heat Insulation

4.3.3 Cable Specifications

Use a shielded cable of 10 to 13.5 mm OD for this wiring as a rule.

4.3.4 Connection to Detector

Connect the cable to the detector taking the following into account:

(1) The cable inlet port of the detector is a thread of G3/4. Use the specified electric wire lead-in utensils. As the detector may be removed for maintenance, allow a sufficient margin for the cable length.

(2) The terminal screws are of M3.5 and M4 type (ISO 3.5 mm and 4 mm). Treat the cable end using crimp-on terminal lugs *1.

*1: If the ambient temperature of the detector-installed location exceeds 60°C, use bare crimp-on terminal lugs.

4.3.5 Connection to Converter

Connect the cable to the converter taking the following into account:

The terminal screws of the converter are of M4 type (ISO 4 mm). Treat the cable end using crimp-on type terminal lugs conforming to this screw size.

4.4 Wiring for Analog Output

This wiring is for transmitting a 4 to 20 mA DC output signal to an instrument, e.g., a recorder. Maintain a load resistance of 550Ω or less.

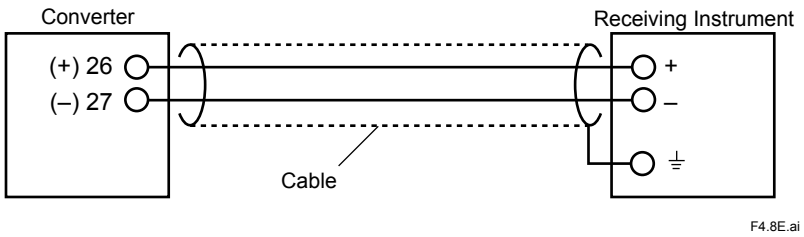


Figure 4.7 Analog Output Wiring

4.4.1 Cable Specifications

Use a two-conductor shielded cable with an OD of 10 to 13.5 mm for this wiring.

4.4.2 Wiring Procedure

(1) The terminal screws of the converter are of M4 type (ISO 4 mm). Treat the cable end using crimp-on type terminal lugs conforming to this screw size. As a rule, ground the cable shield on the side of the instrument connected to the converter.

(2) Do not mistake the polarity of the wiring, that is positive and negative.

4.5 Power and Ground Wiring

CAUTION

Confirm the power supply specifications and supply proper power. If an improper power supply is used, burn-out may occur or operation may be disabled.

These are for supplying driving power and for grounding the converter.

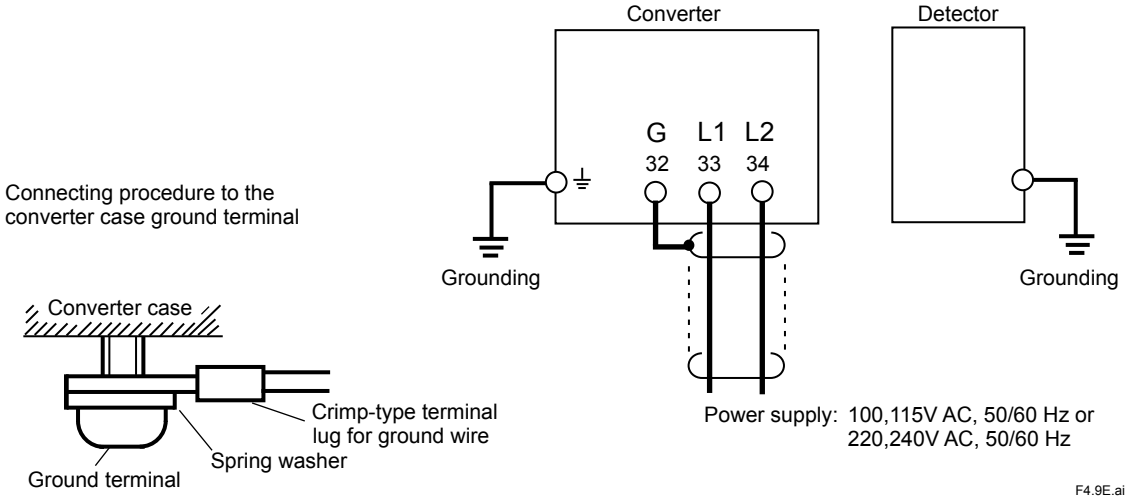


Figure 4.8 Power and Ground wiring

4.5.1 Power Wiring

Connect the cable from the power supply to the converter terminals. Carry out wiring work taking the following points into account:

(1) Use a two-conductor shielded cable with an OD of 10 to 13.5 mm for this wiring.

(2) The terminal screws of the converter are of M4 type (ISO 4 mm). Treat the cable end using crimp-type terminal lugs conforming to this screw size.

(3) If the power line is grounded with either one of its wires, connect the grounded wire to the L2 terminal (terminal number 34).

4.5.2 Ground Wiring

The ground terminal must be grounded.

- Ground the ground terminal according to the standard of JIS class D ground wiring (ground resistance of 100Ω or less) or better.
- Ground the detector at the terminal (screw with the ⏚ mark) at the lower part of the exterior of the detector case (ground screw is M5 (ISO 5 mm) size).
- Ground the converter at the terminal (screw with the ⏚ mark) at the lower part of the converter case or the ground terminal (screw with the ⏚ mark) at the lower part of the rear face of the converter (ground screw is M5 [ISO 5mm] size).
- Use a 600-V grade PVC-insulated wire for grounding.

- If a signal has polarity, exercise care not to mistake the polarity. Connect the ungrounded side wire of the power cable to the specified converter terminal.
- After wiring is completed, check that there is no mistake and loosening in the wiring between the detector and converter, and then mount the cover.

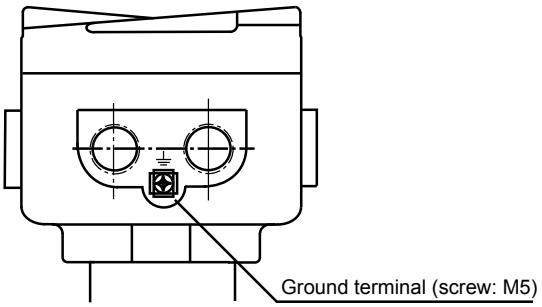


Figure 4.9 Position of the Detector Ground Terminal

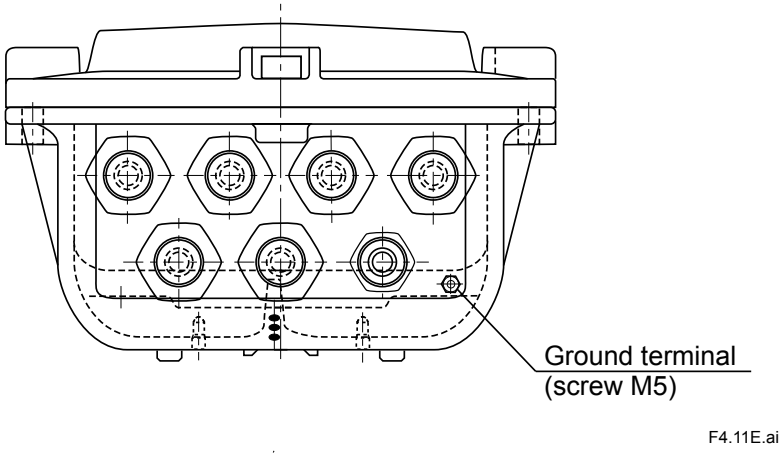
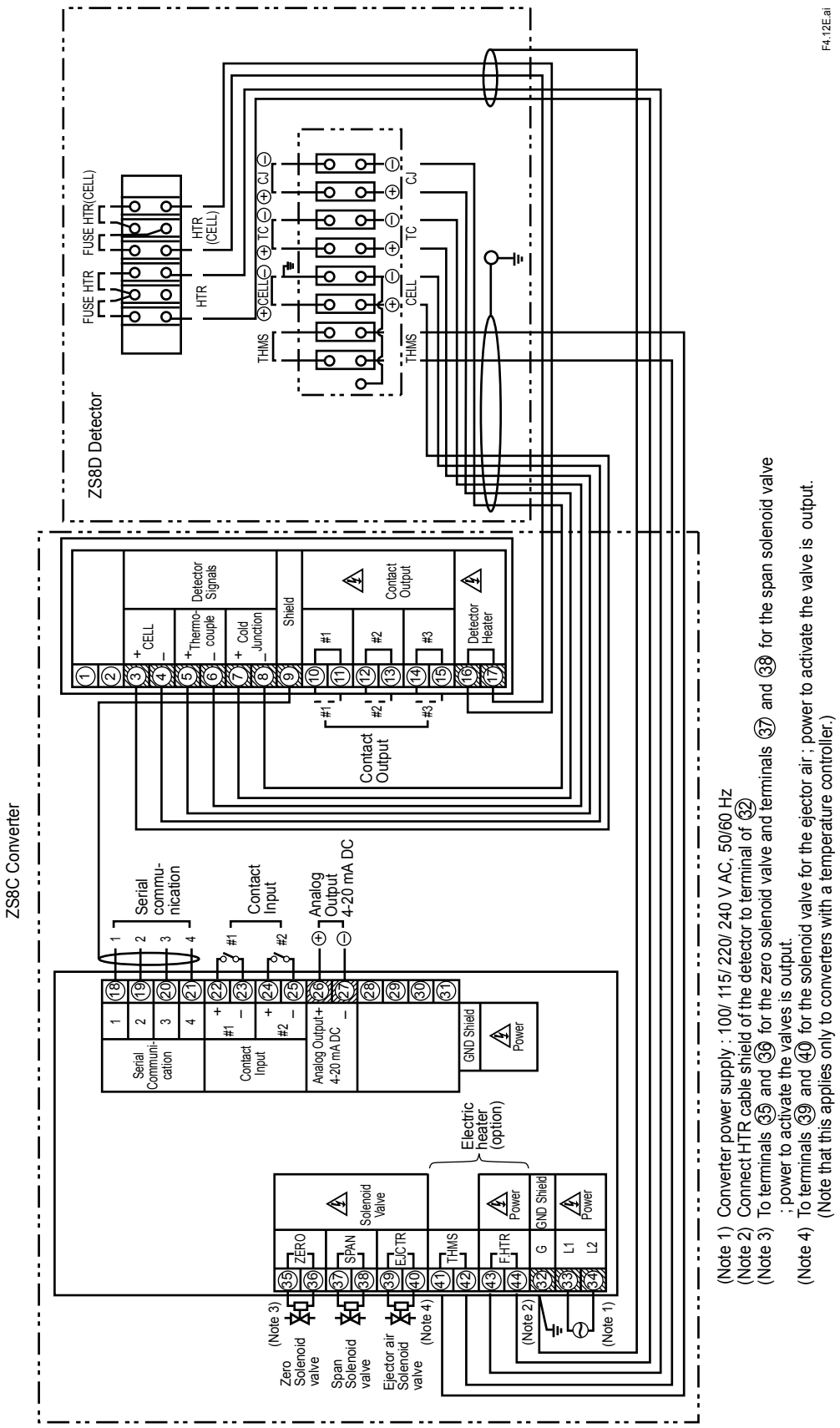


Figure 4.10 Position of the Converter Ground Terminal



(Note 1) Converter power supply : 100/ 115/ 220/ 240 V AC, 50/60 Hz
(Note 2) Connect HTR cable shield of the detector to terminal of ㉜
(Note 3) To terminals ㉟ and ㊱ for the zero solenoid valve and terminals ㊲ and ㊳ for the span solenoid valve ; power to activate the valves is output.
(Note 4) To terminals ㊴ and ㊵ for the solenoid valve for the ejector air ; power to activate the valve is output.
(Note that this applies only to converters with a temperature controller.)

Figure 4.11 Wiring Diagram

4.6 Digital Communication Wiring

If communications via an RS-422-A interface is intended, connect the converter to the personal computer which you are using. This section also describes the ZS8C converter communication specifications as well as wiring procedure.

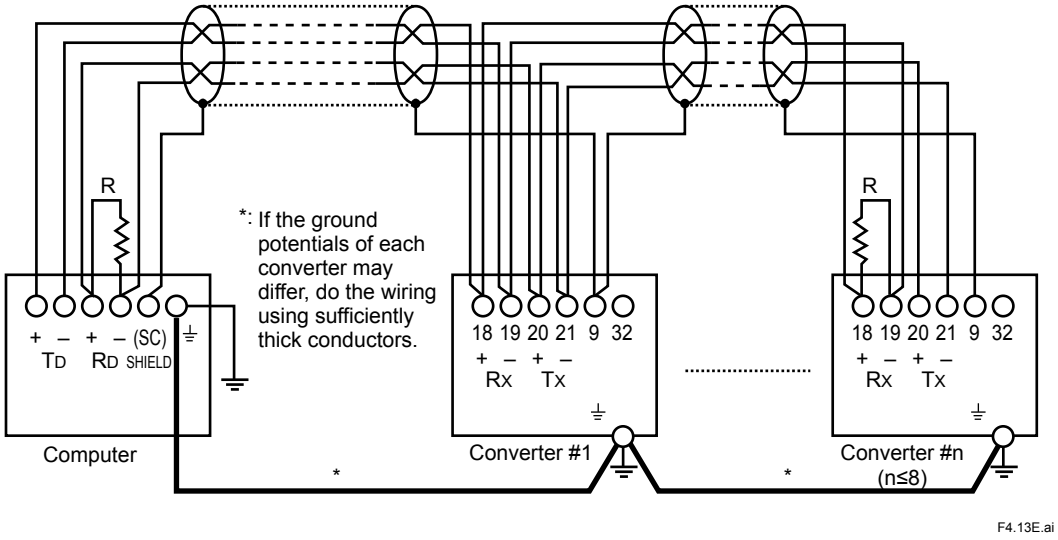
4.6.1 Wiring of RS-422-A Communication Cable

RS-422-A communications can be carried out by connecting up to eight converters to one computer. In the ZS8C converter, communication I/O signals are not isolated. If the computer is located away from the converter (the communication cable length is 15 m or more as a guideline) and thus their ground potentials cannot be equalized, use a computer with an I/O signal isolating interface. Figure 4.12 shows the terminal connections for an RS-422-A communication cable.

Notices in Implementing Wiring

(1) Lay communication cables away from cables which may become noise sources. In addition, lay the adjacent cables so that they are not parallel with each other.

(2) If a computer is to be connected to more than one converter, implement ground wiring so that the ground potentials of each converter are equal.



(Note) Connect the converter terminals R_X to the computer terminal T_D and converter terminals T_X to the computer terminal R_D. R shows the terminating resistance. R= 100Ω, 1/2 W (match it with the cable's impedance).

Figure 4.12 Connections for RS-422-A Communications

Specifications for and Maximum Length of Communication Cable

For an RS-422-A communication cable, use a three twisted-pair cable or a 6-conductor (22 AWG or thicker) shielded cable with an OD of 10 to 13.5 mm so that the cable impedance is 100Ω and cable capacitance is 50 pF/m or less. It is recommended that the cable length be within 15 m to balance the ground potentials. However, if a computer with an I/O signal isolating interface is used, the cable length may be extended up to 500 m. In this case, do the ground system wiring in the procedure shown in Figure 4.13.

As the end-treatment for the cable wires, attach crimp-on terminal lugs conforming to M4 screws to the ends of the wires which are connected to converter terminals. The length of the conductors exposed, over which the cable shield is stripped, should be as short as possible.

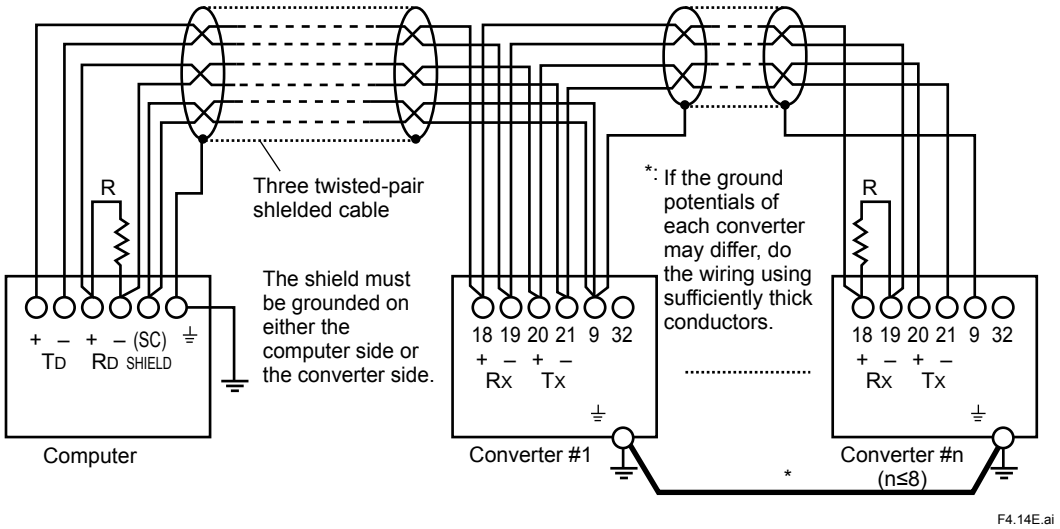


Figure 4.13 Connection for RS-422-A Communications (when using an I/O signal isolating computer)

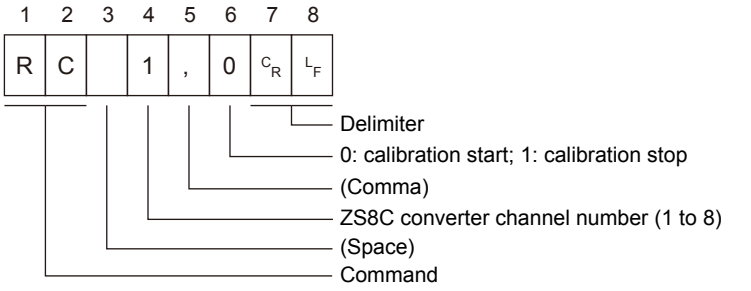
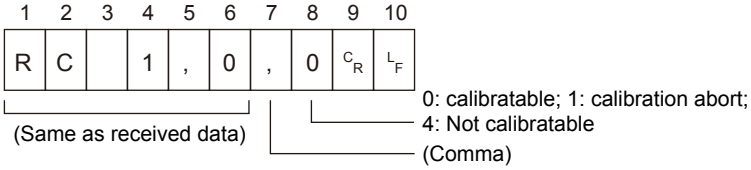
4.6.2 ZS8C Converter Communication (RS-422-A) Specifications

- **Communication Specifications**

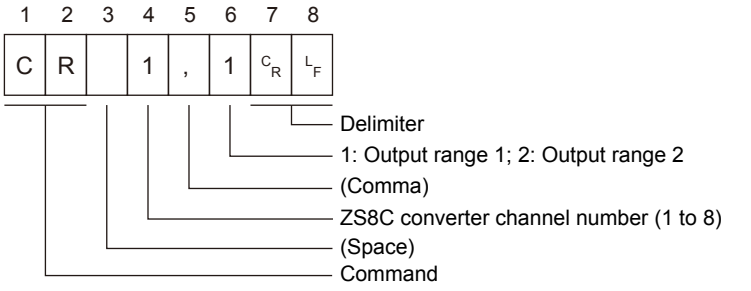
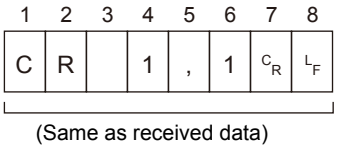
Classification	Item	Description
Specifications	Signal level	Conforming to EIA RS-422-A standards I/O signal not isolated
	Communication system	Start-stop system, Half duplex, RS-422-A: Four-wire multi-drop connection Computer: converter=1:N (N=1 to 8)
	Communication distance	RS-422-A: Up to 500m (between an I/O signal isolated computer and ZS8C converter
	Communication rate	2400, 4800 or 9600 bps (switching)
	Transmission procedure	No procedure or handshaking, switching 'No procedure' available only for data transmission (transmission period: 10 seconds)
	Data length	8 bits
	Parity	None
	Start bit	1
	Stop bit	1
	Communication code	ASCII code
Contents	Reception	(1) Zero and span calibration request, calibration abort request (2) Analog output range selection signal
	Transmission	Time, O_2 concentration (wet and dry), cell emf, cell temperature, error code, alarm code, status number, calibration coefficient, cell resistance, response time, cell life, O_2 average, O_2 averaging time, maximum and minimum O_2 concentration, output current, and date and time of calibration start

● Command Interpretation

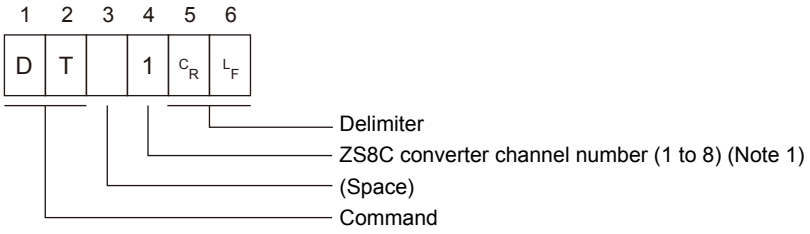
(1) RC (Request Calibration)

Function	”Zero and span calibration start request” signal, or “calibration abort” signal (Note) Set the ZS8C converter calibration mode to “Auto” or “Semi-auto.”
Data structure	(1) Received data  (2) Transmitted data 

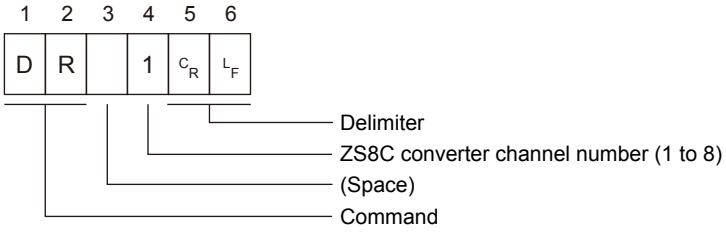
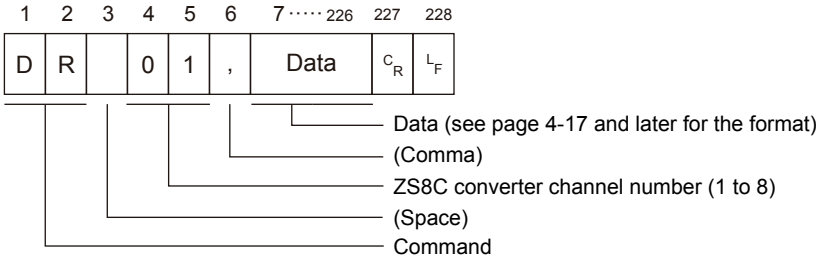
(2) CR (Change Range)

Function	”Analog output range selection” signal (Note) The ZS8C converter contact input signal has priority.
Data structure	(1) Received data  (2) Transmitted data 

(3) DT (Data Trigger)

Function		The latest measured data and the date & time are taken into the communication memory inside the ZS8C converter.
Data structure		(1) Received data  (Note 1) For channel number "0," measured data are taken simultaneously in all the converters. (Note 2) Data retained with the DT command are transmitted to the computer by the DR command. (Note 3) If a "DT 0 C_R L_F" command is transmitted from the computer to the converter, allow an interval of one second or longer until the next command (for example, a DR command) is sent.
Receiving format	When setting	D T 1 C_R L_F
	When reading	None
Transmitting format		D T 1 C_R L_F

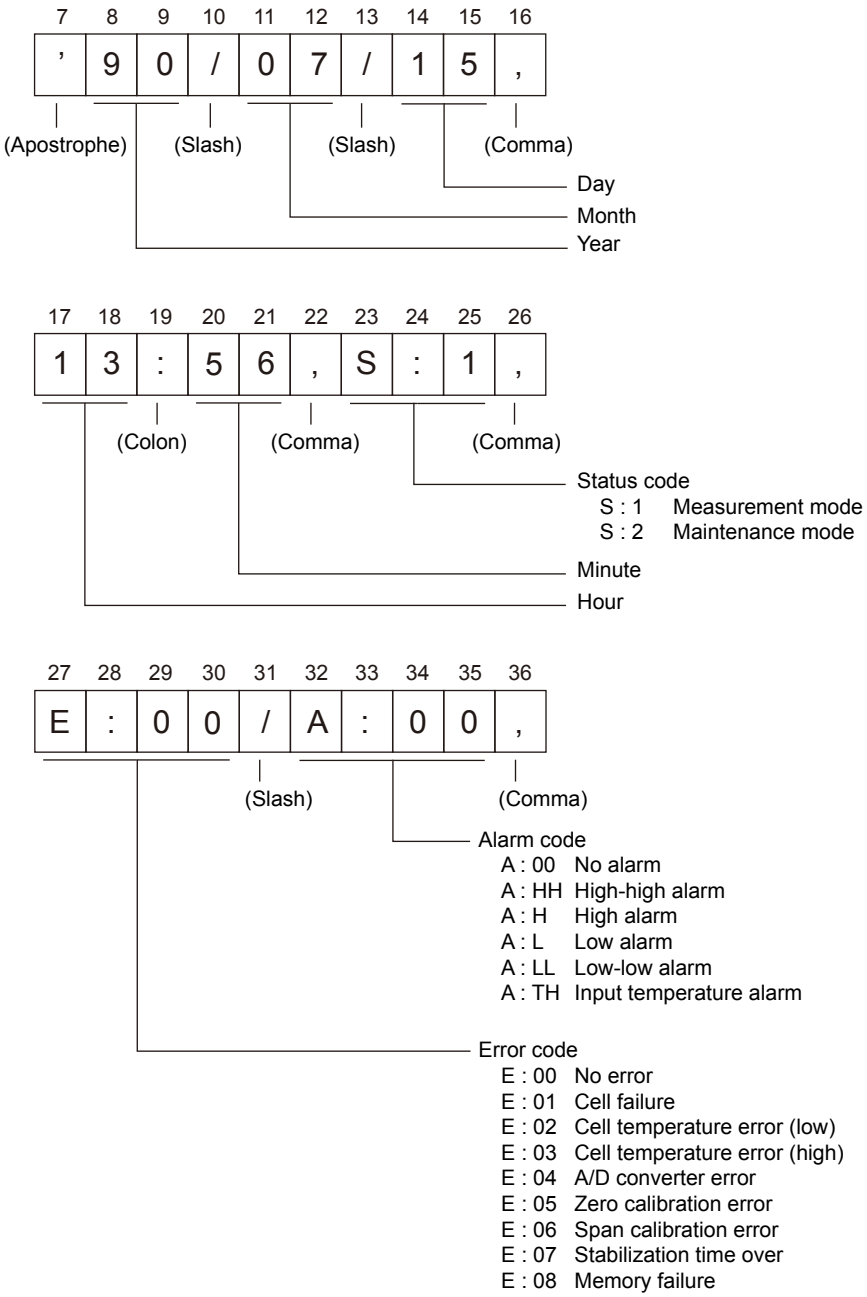
(4) DR (Data Read)

Function		This command can make the ZS8C converter transmit data & time and measured data.
Data structure		(1) Received data  (2) Transmitted data 
Receiving format	When setting	None
	When reading	D R 1 C_R L_F

(Note) Answer-back signals for commands other than the "DT 0 C_R L_F" command may be sent by placing them after the undefined code for two characters depending on the signal circuit switching state.

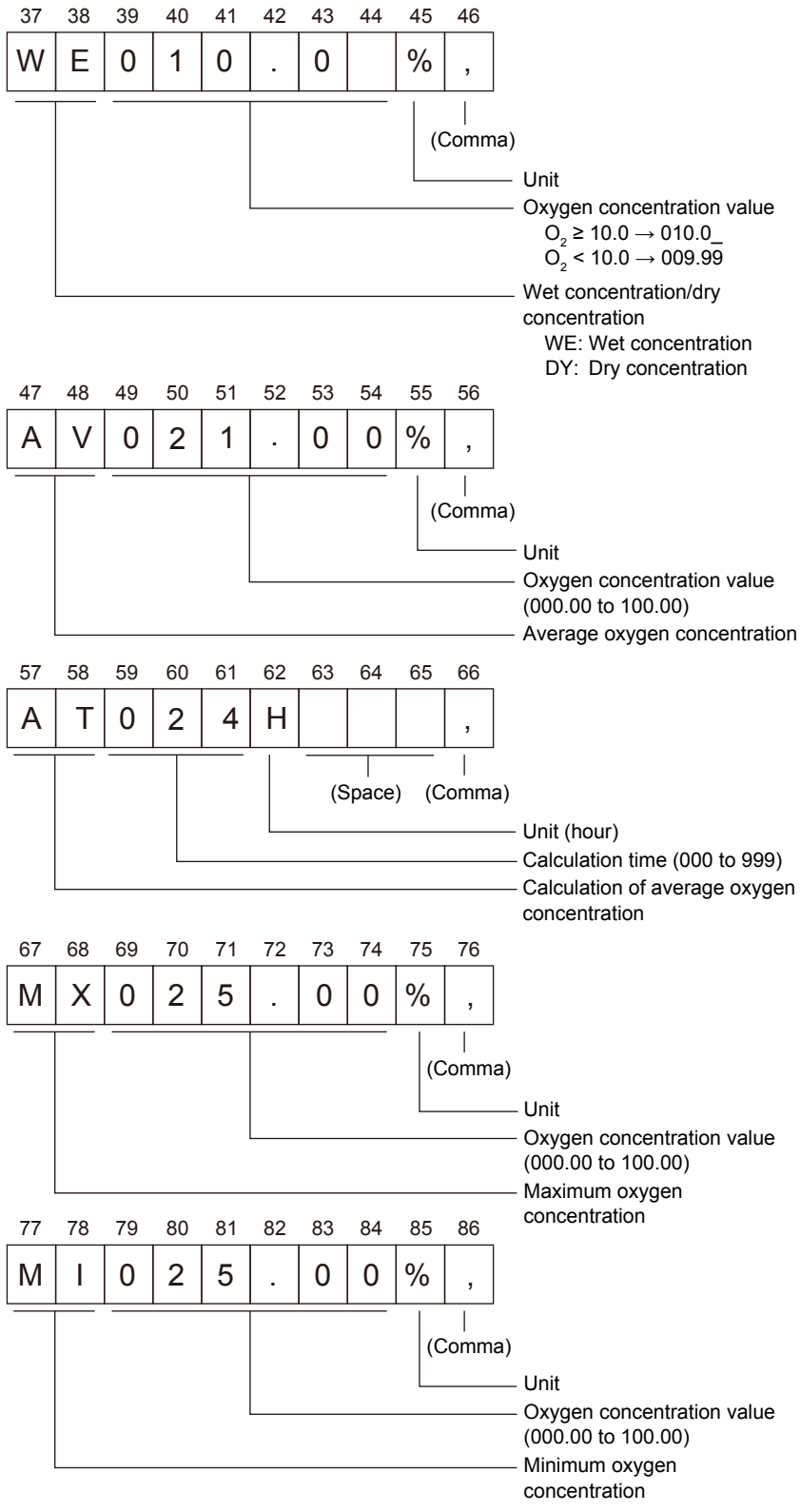
Data Format for DR Command Communication (Transmission) (1)

Transmission format (data)


7 8 9 10 11 12 13 14 15 16
' 9 0 / 0 7 / 1 5 ,
(Apostrophe)
(Slash)
(Slash)
(Comma)
Day
Month
Year
17 18 19 20 21 22 23 24 25 26
1 3 : 5 6 , S : 1 ,
(Colon)
(Comma)
(Comma)
Status code
S : 1 Measurement mode
S : 2 Maintenance mode
Minute
Hour
27 28 29 30 31 32 33 34 35 36
E : 0 0 / A : 0 0 ,
(Slash)
(Comma)
Alarm code
A : 00 No alarm
A : HH High-high alarm
A : H High alarm
A : L Low alarm
A : LL Low-low alarm
A : TH Input temperature alarm
Error code
E : 00 No error
E : 01 Cell failure
E : 02 Cell temperature error (low)
E : 03 Cell temperature error (high)
E : 04 A/D converter error
E : 05 Zero calibration error
E : 06 Span calibration error
E : 07 Stabilization time over
E : 08 Memory failure

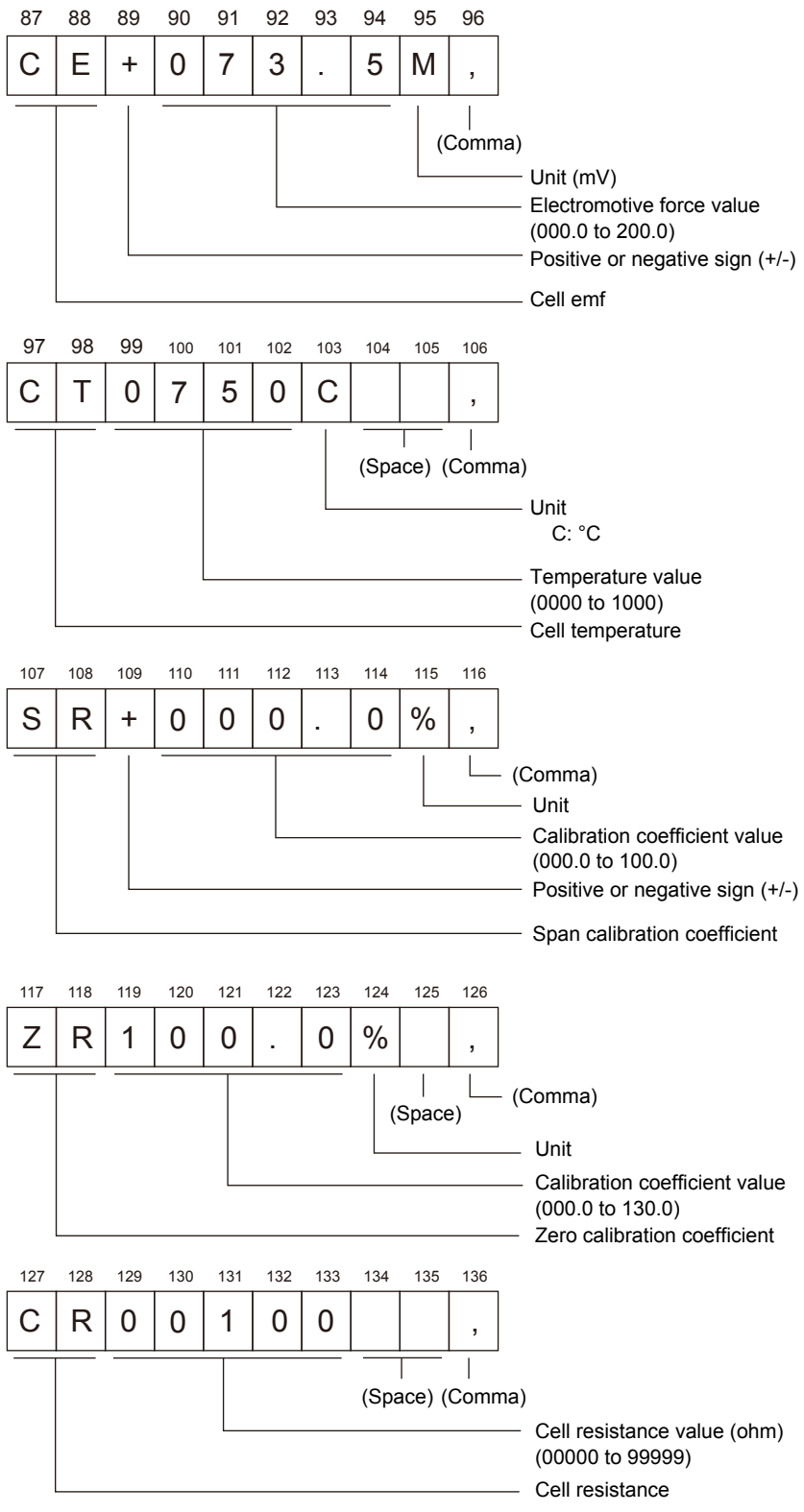
Data Format for DR Command Communication (2)

Transmission format (data)


37 38 39 40 41 42 43 44 45 46
W E 0 1 0 . 0 % ,
(Comma)
Unit
Oxygen concentration value
O2 ≥ 10.0 → 010.0_
O2 < 10.0 → 009.99
Wet concentration/dry concentration
WE: Wet concentration
DY: Dry concentration
47 48 49 50 51 52 53 54 55 56
A V 0 2 1 . 0 0 % ,
(Comma)
Unit
Oxygen concentration value (000.00 to 100.00)
Average oxygen concentration
57 58 59 60 61 62 63 64 65 66
A T 0 2 4 H , ,
(Space) (Comma)
Unit (hour)
Calculation time (000 to 999)
Calculation of average oxygen concentration
67 68 69 70 71 72 73 74 75 76
M X 0 2 5 . 0 0 % ,
(Comma)
Unit
Oxygen concentration value (000.00 to 100.00)
Maximum oxygen concentration
77 78 79 80 81 82 83 84 85 86
M I 0 2 5 . 0 0 % ,
(Comma)
Unit
Oxygen concentration value (000.00 to 100.00)
Minimum oxygen concentration

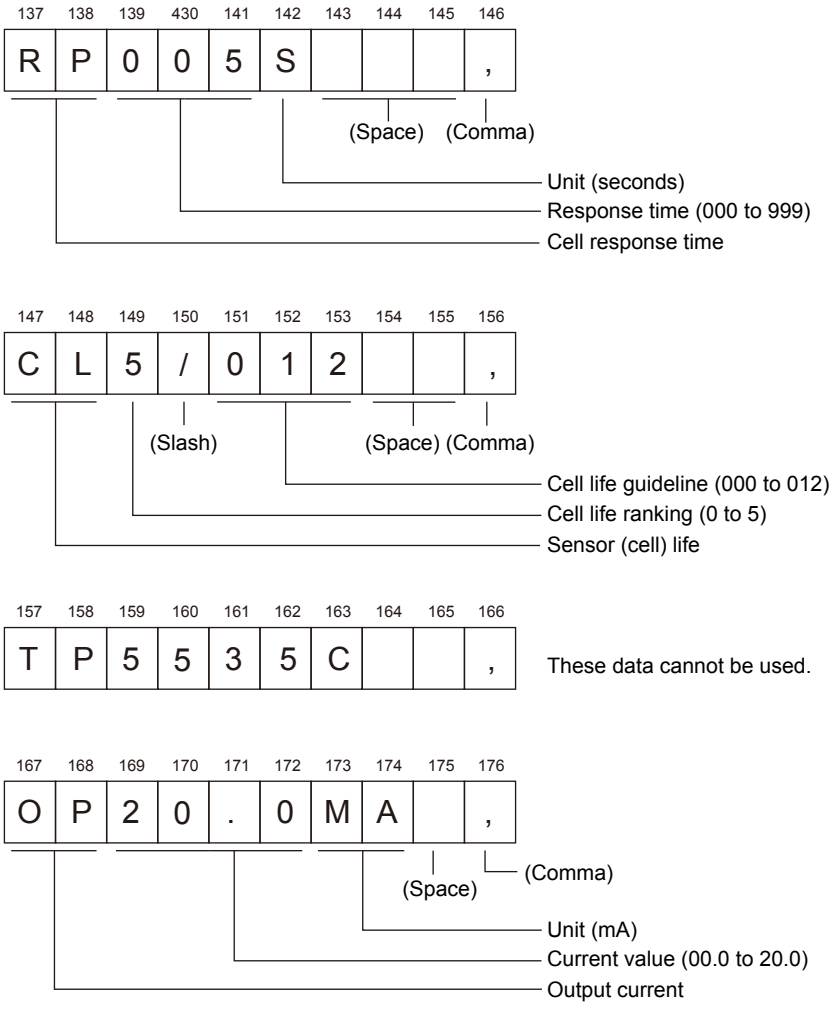
Data Format for DR Command Communication (3)

Transmission format (data)


87 88 89 90 91 92 93 94 95 96
C E + 0 7 3 . 5 M ,
(Comma)
Unit (mV)
Electromotive force value
(000.0 to 200.0)
Positive or negative sign (+/-)
Cell emf
97 98 99 100 101 102 103 104 105 106
C T 0 7 5 0 C , ,
(Space) (Comma)
Unit
C: °C
Temperature value
(0000 to 1000)
Cell temperature
107 108 109 110 111 112 113 114 115 116
S R + 0 0 0 . 0 % ,
(Comma)
Unit
Calibration coefficient value
(000.0 to 100.0)
Positive or negative sign (+/-)
Span calibration coefficient
117 118 119 120 121 122 123 124 125 126
Z R 1 0 0 . 0 % , ,
(Space)
(Comma)
Unit
Calibration coefficient value
(000.0 to 130.0)
Zero calibration coefficient
127 128 129 130 131 132 133 134 135 136
C R 0 0 1 0 0 , ,
(Space) (Comma)
Cell resistance value (ohm)
(00000 to 99999)
Cell resistance

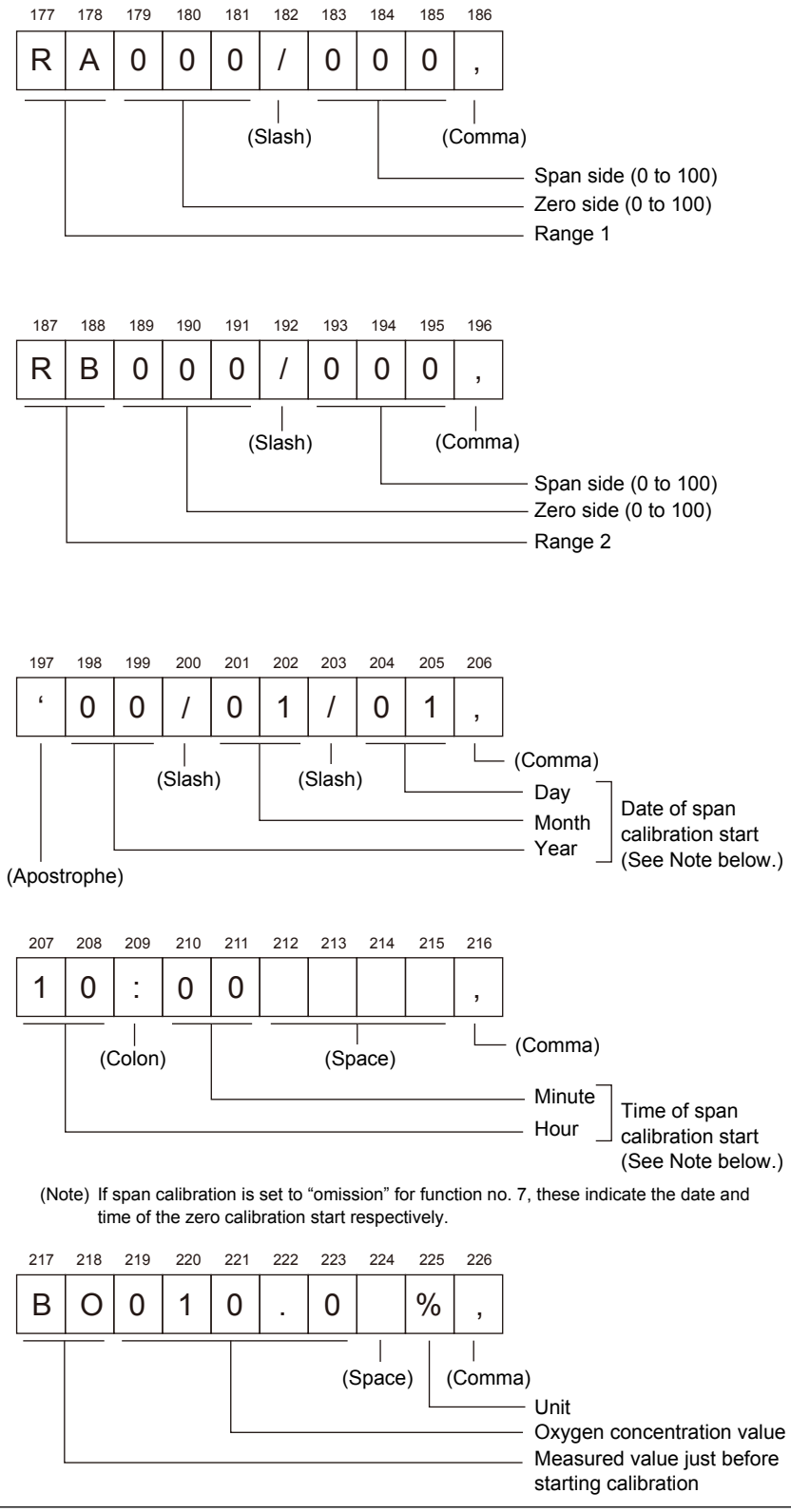
Data Format for DR Command Communication (4)

Transmission format (data)


137 138 139 430 141 142 143 144 145 146
R P 0 0 5 S , (Space) (Comma)
Unit (seconds)
Response time (000 to 999)
Cell response time
147 148 149 150 151 152 153 154 155 156
C L 5 / 0 1 2 , (Slash) (Space) (Comma)
Cell life guideline (000 to 012)
Cell life ranking (0 to 5)
Sensor (cell) life
157 158 159 160 161 162 163 164 165 166
T P 5 5 3 5 C ,
These data cannot be used.
167 168 169 170 171 172 173 174 175 176
O P 2 0 . 0 M A , (Space) (Comma)
Unit (mA)
Current value (00.0 to 20.0)
Output current

Data Format for DR Command Communication (5)

Transmission format (data)


177 178 179 180 181 182 183 184 185 186
R A 0 0 0 / 0 0 0 ,
(Slash)
(Comma)
Span side (0 to 100)
Zero side (0 to 100)
Range 1
187 188 189 190 191 192 193 194 195 196
R B 0 0 0 / 0 0 0 ,
(Slash)
(Comma)
Span side (0 to 100)
Zero side (0 to 100)
Range 2
197 198 199 200 201 202 203 204 205 206
‘ 0 0 / 0 1 / 0 1 ,
(Comma)
(Slash)
(Slash)
Day
Month
Year
Date of span calibration start (See Note below.)
(Apostrophe)
207 208 209 210 211 212 213 214 215 216
1 0 : 0 0 , (Comma)
(Colon)
(Space)
Minute
Hour
Time of span calibration start (See Note below.)
217 218 219 220 221 222 223 224 225 226
B O 0 1 0 . 0 % ,
(Space)
(Comma)
Unit
Oxygen concentration value
Measured value just before starting calibration

(Note) If span calibration is set to “omission” for function no. 7, these indicate the date and time of the zero calibration start respectively.

4.7 Contact Output Wiring

The converter can output a maximum of three contact signals. These contact outputs can be used for 13 applications (see Subsection 6.1.8) freely selecting up to three required items, e.g., “low-limit alarm” or “high-limit alarm.” When using these contact outputs, do the wiring as illustrated below.

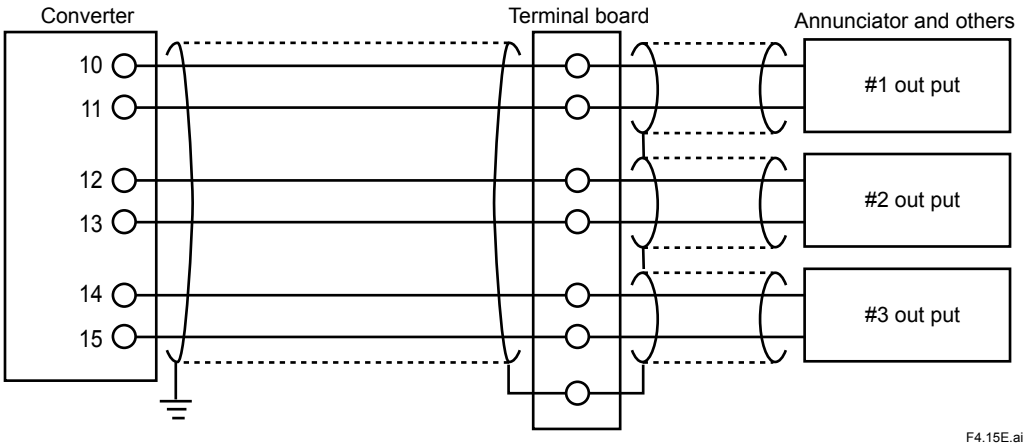


Figure 4.14 Contact Output Wiring

4.7.1 Cable Specifications

Use a cable with an OD of 10 to 13.5 mm (The number of cores in cable depends on the number of contacts used) for this wiring.

4.7.2 Wiring Procedure

(1) The terminal screws of the converter are of M4 size (ISO 4 mm). Treat the cable end using crimp-on terminal lugs conforming to this screw size.

(2) The contact rating of relays for contact output is 30 V DC, 2 A or 250 V AC, 2 A. Connect the loads (indicator lamps, annunciators or others) so as to satisfy these values.

4.8 Contact Input Wiring

The converter can respond to a maximum of two contact input signals received. These contact input signals can be selected from five types of signals, e.g., the “range selection command” or “calibration gas under-pressure alarm.” When using these contact inputs, do the wiring as illustrated below.

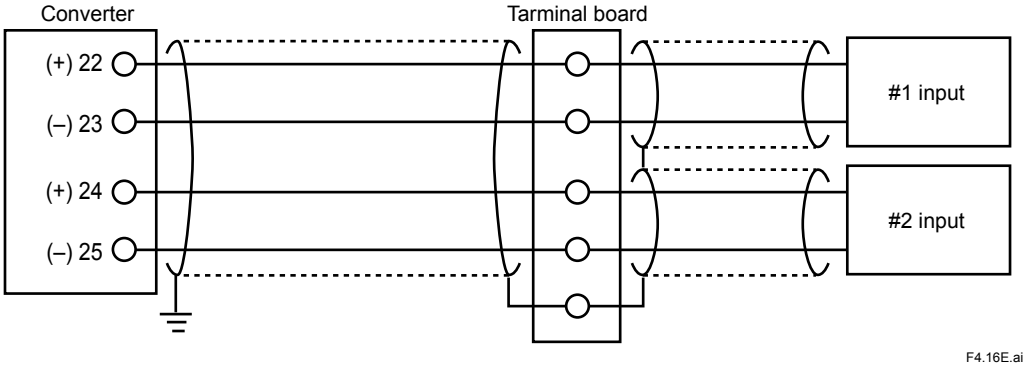


Figure 4.15 Contact Input Wiring

4.8.1 Cable Specifications

Use a 2-conductor cable (for one-point contact input) or 4-conductor cable (for two-point contact inputs) with an OD of 10 to 13.5 mm for this wiring.

4.8.2 Wiring Procedure

(1) The terminal screws of the converter are of M4 size (ISO 4 mm). Treat the cable end using crimp-on terminal lugs conforming to this screw size.

(2) The on / off levels of this contact are identified by resistances or voltages. Use a device to be connected which satisfies the conditions shown in Table 4.4.

Table 4.4 Identification of Contact Input On/Off Levels

	ON	OFF
Resistance value (contact)	200 ohm or less	100 kohm or more
Voltage value	−1 to 1 V DC	4.5 to 25 V DC

4.9 Wiring for Solenoid Valve

Because there is power to supply the contact of solenoid valve for auto - calibration (Zero, Span) and Stopping of ejector (Note), the external power is unnecessary.

Please joint the solenoid valve to contact in suitable capacity.

Contact capacity of solenoid for calibration	250 V AC, 1 A (SSR output, leakage current (When power is off) : below 3 mA
Contact capacity of solenoid for stopping of ejector	250 V AC, 1 A (Resistance load)

Note: In case of electric heat - insulating of detector, if the temperature come to less or equal 155°C (Or when the power is off), the ejector would be stopped.

5. Components and Their Functions

This chapter describes the components of main units composing the EXA OXY flameproof zirconia oxygen analyzer and their functions.

5.1 Detector

5.1.1 General-purpose Detector

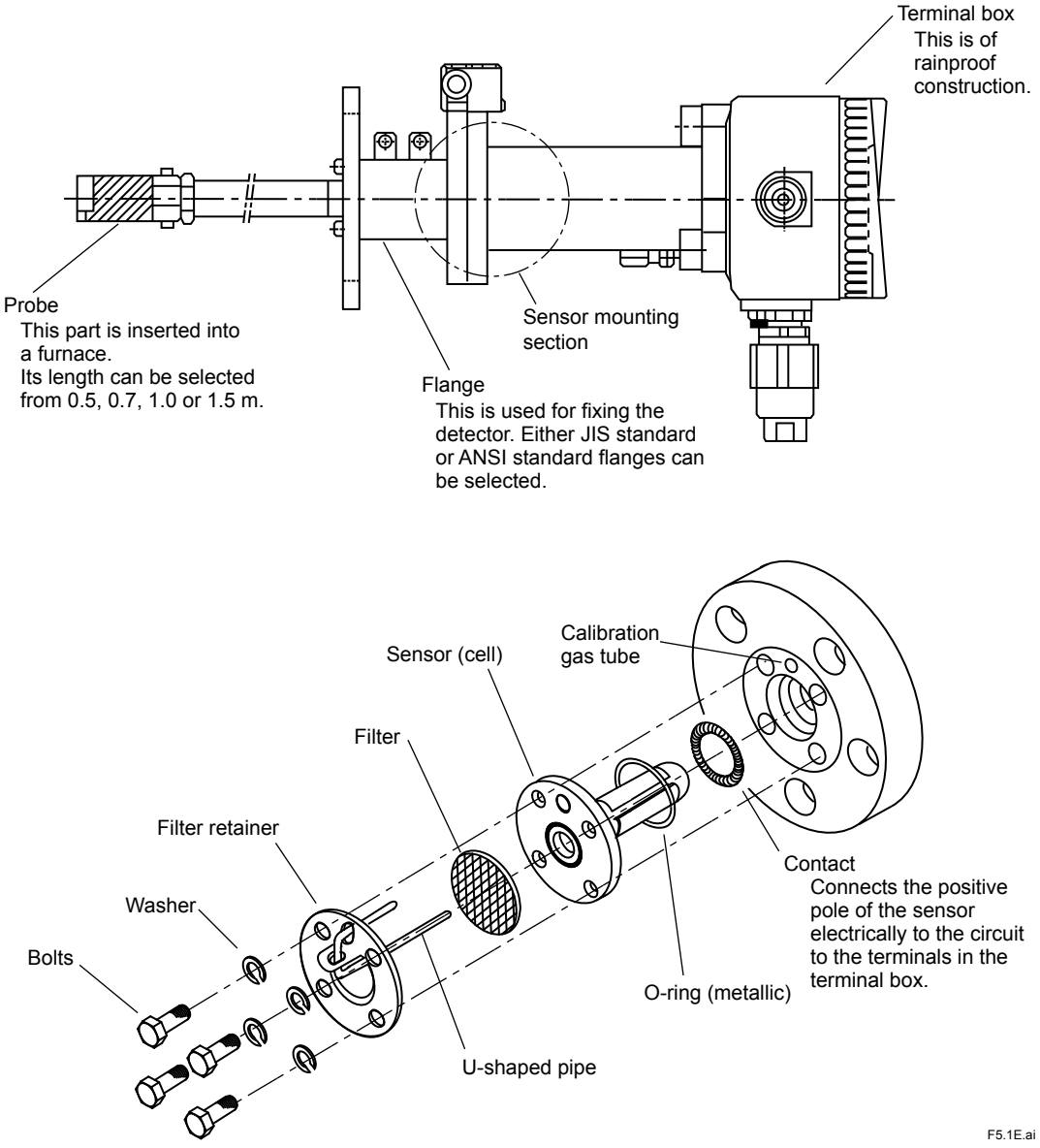

Terminal box
This is of rainproof construction.
Probe
This part is inserted into a furnace.
Its length can be selected from 0.5, 0.7, 1.0 or 1.5 m.
Sensor mounting section
Flange
This is used for fixing the detector. Either JIS standard or ANSI standard flanges can be selected.
Calibration gas tube
Sensor (cell)
Filter
Filter retainer
Washer
Bolts
Contact
Connects the positive pole of the sensor electrically to the circuit to the terminals in the terminal box.
O-ring (metallic)
U-shaped pipe
F5.1E.ai

Figure 5.1 Components of Sensor Mounting Section and Their Functions

5.1.2 High-temperature Detector (with a high-temperature probe adaptor)

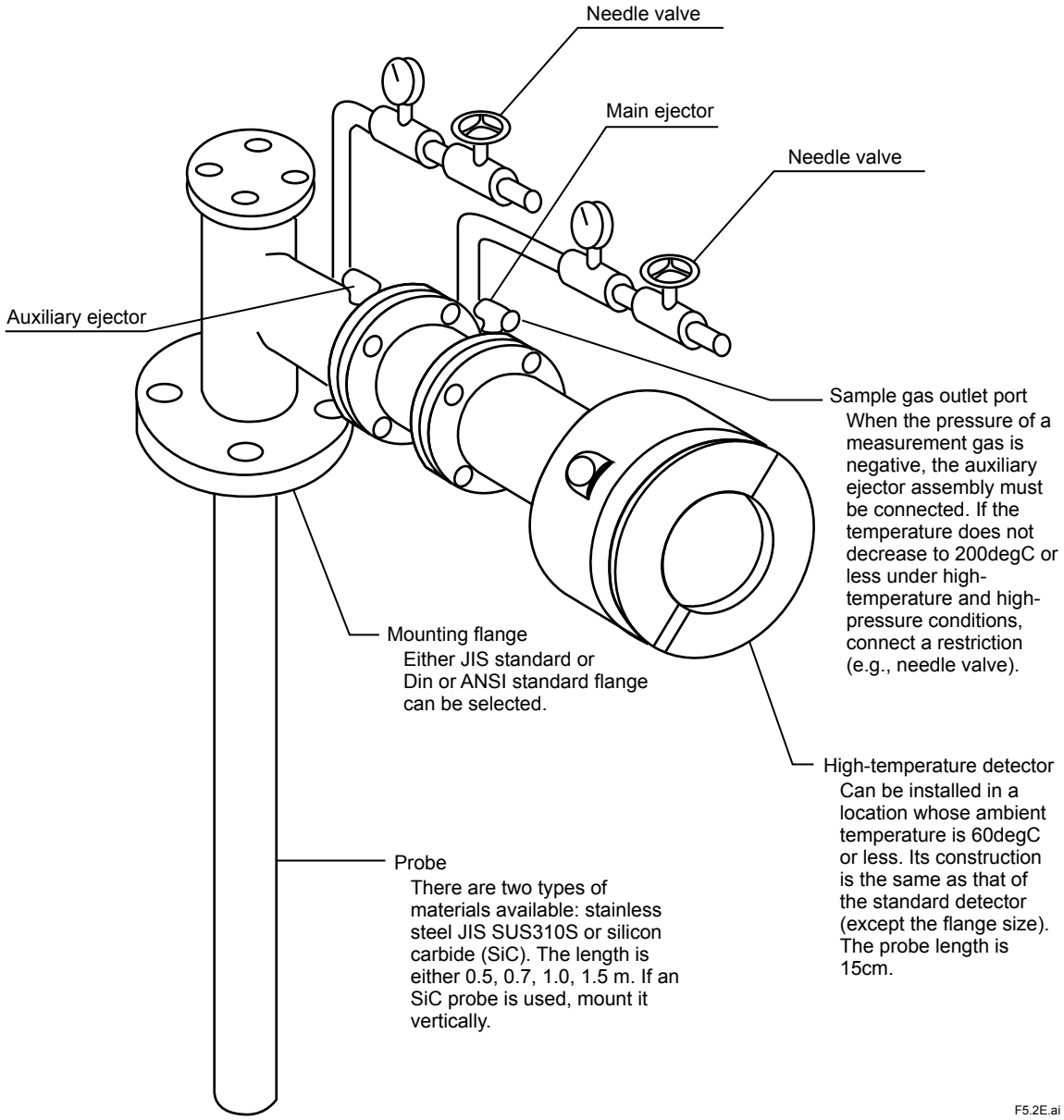

Needle valve
Main ejector
Needle valve
Auxiliary ejector
Sample gas outlet port
When the pressure of a measurement gas is negative, the auxiliary ejector assembly must be connected. If the temperature does not decrease to 200degC or less under high-temperature and high-pressure conditions, connect a restriction (e.g., needle valve).
Mounting flange
Either JIS standard or Din or ANSI standard flange can be selected.
High-temperature detector
Can be installed in a location whose ambient temperature is 60degC or less. Its construction is the same as that of the standard detector (except the flange size). The probe length is 15cm.
Probe
There are two types of materials available: stainless steel JIS SUS310S or silicon carbide (SiC). The length is either 0.5, 0.7, 1.0, 1.5 m. If an SiC probe is used, mount it vertically.
F5.2E.ai

Figure 5.2 Components of High-temperature Detector and Their Functions

5.2 Converter

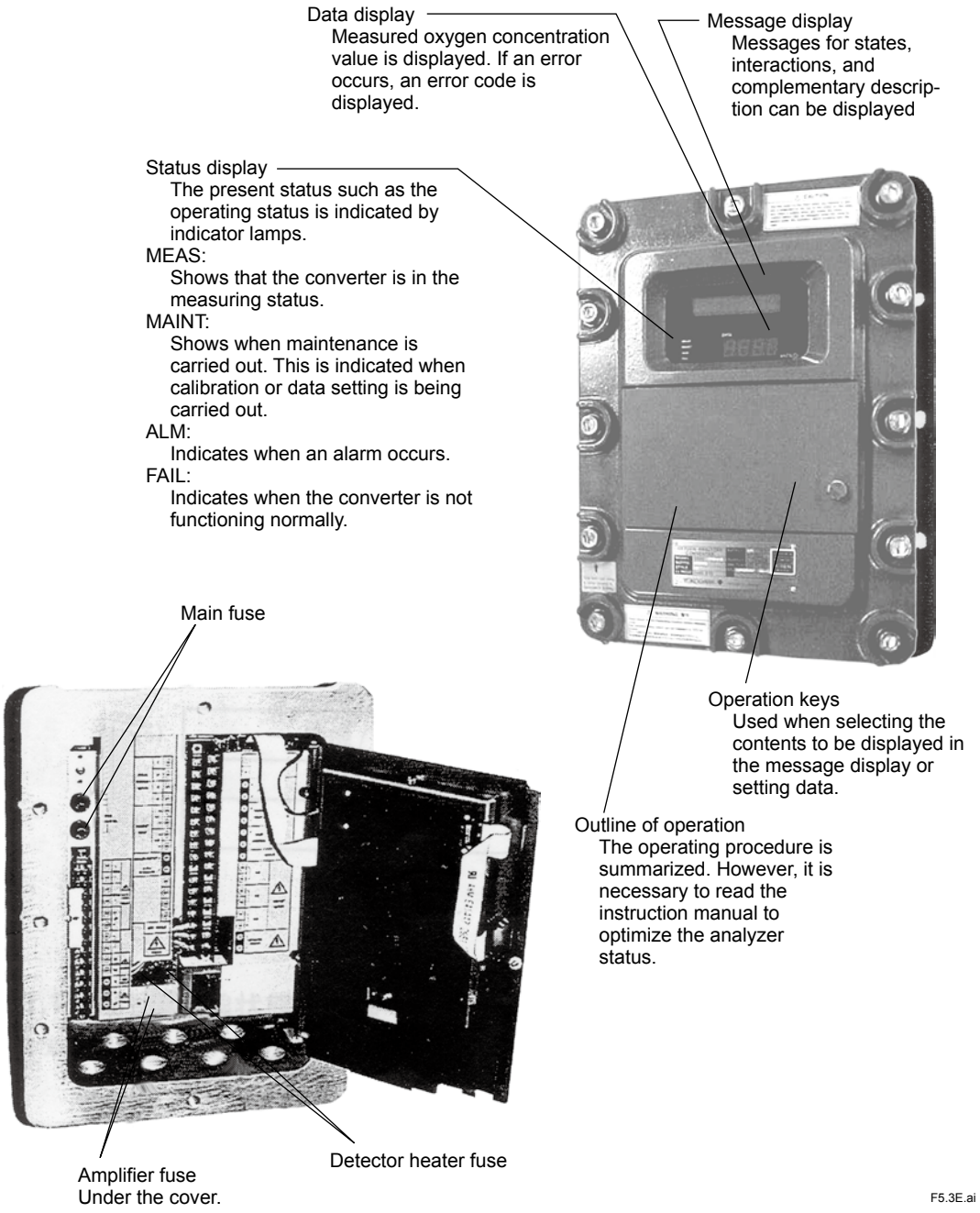
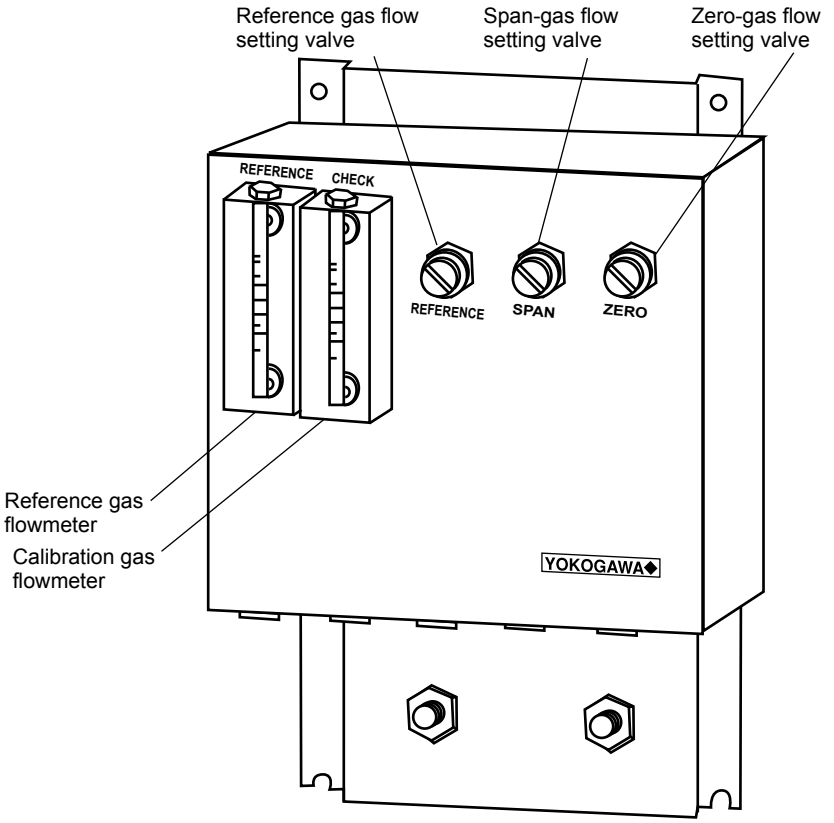

Data display
Measured oxygen concentration value is displayed. If an error occurs, an error code is displayed.
Message display
Messages for states, interactions, and complementary description can be displayed
Status display
The present status such as the operating status is indicated by indicator lamps.
MEAS:
Shows that the converter is in the measuring status.
MAINT:
Shows when maintenance is carried out. This is indicated when calibration or data setting is being carried out.
ALM:
Indicates when an alarm occurs.
FAIL:
Indicates when the converter is not functioning normally.
Main fuse
Operation keys
Used when selecting the contents to be displayed in the message display or setting data.
Outline of operation
The operating procedure is summarized. However, it is necessary to read the instruction manual to optimize the analyzer status.
Amplifier fuse
Under the cover.
Detector heater fuse
F5.3E.ai

Figure 5.3 Components of the Converter and Their Functions

5.3 Flow Setting Unit



ZA8F Flow Setting Unit

F5.4E.ai

Figure 5.4 Components of Flow Setting Unit and Their Functions

6. Operation

In this Chapter, the basic operation methods for the EXA OXY Explosion proof Zirconia Oxygen Analyzer are described.

6.1 Startup

The general procedures for starting up are as follows:

(1) Inspect the piping & wiring conditions — See Section 6.1.1.

↓

(2) Check the heat insulation conditions — See Section 6.1.2.

↓

(3) Check the status of set valves — See Section 6.1.3.

↓

(4) Supply power to the converter — See Section 6.1.4.

↓

(5) Warm up & set the data — See Sections 6.1.5 and 6.1.6. To set data, enter the password “16”.

↓

(6) Calibrate — See Section 6.1.9.

↓

Stationary operation

(Note) Also check for normal operation of alarm output, etc. before starting up stationary operation, if possible.

6.1.1 Inspection of Piping and Wiring Conditions

In referring to Chapters 3 and 4, inspect the piping and wiring to see that they are correctly installed.

6.1.2 Checking the Heat Insulation Conditions

For heat insulation with steam, check that steam is supplied to the copper pipe for heat insulation with steam, which is connected to the flame arrester, and that the flame arrester is sufficiently heated. Also check that the flame arrester and the detector's main ejector are sufficiently heat-insulated with insulating materials.

Note: Set the steam pressure so that the heat-insulation temperature is the dew point of sulfuric acid for the measuring gas +10°C.

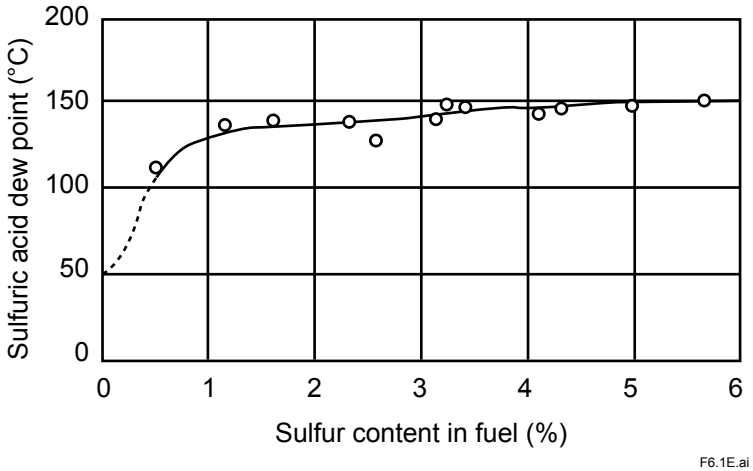


Figure 6.1 Sulfuric Content in Fuel and Sulfuric Acid Dew Point (for reference)

6.1.3 Checking of Set Valves

Inspect the valves as follows depending on your system:

(1) If a needle valve is mounted at the calibration gas inlet of the detector, completely open this valve beforehand.

(2) When instrument air is used as the reference gas, set the secondary pressure of the air so that the air pressure becomes 70 to 100 kPa. In addition, to set the opening, rotate the shaft of the reference gas flow adjust valve “REFERENCE” in the flow setting unit so that the flow rate changes to about 0.3 l/min. Flow rate increases by rotating the valve screw counterclockwise. Before rotating the screw, loosen the lock nut. After the completion of the setting, be sure to tighten the lock nut again.

(Note) The setting of the calibration gas flow will be performed later. Keep the relevant needle valve in the flow setting unit fully close.

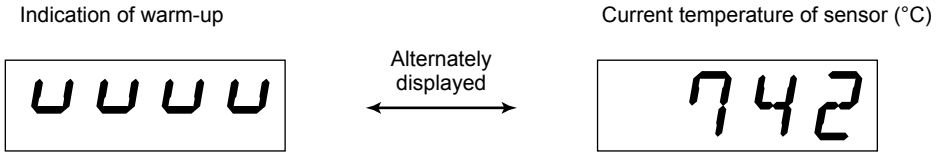
6.1.4 Supplying Power to Converter

Check that the supplied voltage meets the specifications of your converter (see 2.4) and then turn on the power to the converter. In addition, turn ON the main switch on the converter (on the left side of the external wire terminals). At that time, the converter will begin to operate. However, measurement will not take effect for about 10 minutes because the sensor of the detector will not have reached the specified temperature.

All of the set parameters, etc. will also be in a default state, so enter data as required (see 6.1.5).

The display will be as shown in Figure 6.2 immediately after the power is turned ON.

Set the calibration gas concentration, measuring ranges and other required items while the sensor's heater temperature increases.



(Note) The message display indicates the message for the next operation.
Example: [SET PRESENT TIME ENTER TO CODE(F0)]

Figure 6.2 Readout Upon Turning ON Power and During Warm-Up (Data Display)

Note: Approximately an hour after the power is applied, supply ejector air for measurement gas suction. (After warming-up the detector, even in measurement mode, if the piping temperature is lower than a sulfuric acid dew point, the gas flow line may clog.)

6.1.5 During Warming-up

The warm-up period before measurement can begin (i.e., until the detector sensor reaches the specified temperature) is about 10 minutes from the time the power is turned ON. Since measuring operations are suspended during this time, you can take this opportunity to set the data. The analog output signal during the warm-up period reads an O_2 value of 0%. (However, this indicates a default. When Function No. D-2 is adjusted to “PRESET”, the preset value is set.)

After completion of the warm-up period, the data display indicates the measured oxygen concentration.

6.1.6 Data Setting (To set data, enter the password “16”)

With the EXA OXY Explosion-proof Zirconia Oxygen Analyzer, you can have the most suitable operation and measurement functions for your individual processes by setting the various data.

Basic data, e.g., parameters required for operation, are stored in EEPROM in the converter. Temporary data, as set forth individually, are stored in the RAM. The temporary data, read in the RAM, are preserved through the backup of an electric double-layer capacitor for a short time even if the main power supply fails. After that, however, the data in the RAM is lost while the stored data in the converter changes to a default state.

Also upon shipment, the data read and loaded into the converter are in the default state. Thus, upon commencement of operation, set the data to match each operation. Table 6.1 shows the setting items and their default values. Refer to it when setting data. In addition, to enter the password 16 or key operations when data is set, see Chapter 8.

Table 6.1 Settable Items and Their Defaults

Group	No.	Setting range or default details		Default	LCD display	Setting
Calibration	C-0	Span gas concentration : 4.5 to 100 vol% O_2		21.00 % O_2	21.0	
	C-1	Zero gas concentration : 0.3 to 100 vol% O_2		1.00 % O_2	1.00	
	C-2	Mode : One-touch(TCH)/Semi-Auto(SEM) / Auto(AT)		TCH	2: TCH	
	C-3	Stabilizing time : 0 to 10 minutes		3.0 min	3.0 minutes	
	C-4	Calibration time : 0 to 10 minutes		3.0 min	3.0 minutes	
	C-5	Calibration interval : 0 to 255 day or 0 to 23 hours		1day	1day	
	C-6	Calibration start time : Month, Day, Hour, Minute				
	C-7	Skip : None (0), Span(1), Zero (2)		0 : NONE	0 : NONE	
Analog output	D-0	Range 1 : 0 to 25 vol% O_2		0 to 10 % O_2	000–010 % O_2	
	D-1	Range 2 : 0 to 25 vol% O_2		0 to 25 % O_2	000–025 % O_2	
	D-2	Hold : None (N), HLD, P-HLD		HOLD	1 : HLD	
	D-3	Selection : 4 to 20 mA or 0 to 20 mA		4 to 20 mA DC	0 : 4–20 mA	
	D-4	Output characteristic selection : Linear/Log		Linear	0 : Linear	
	D-5	Smoothing constant : 0 to 255 sec.		0 sec.	000 sec	
	D-6	Wet gas O_2 / Dry gas O_2		Wet gas O_2	0:WET	
Alarm	E-0	Extreme Upper limit/ Upper limit : 0 to 100.0 % O_2		Both 0 (none)	HH=0, HI=0	
	E-1	Extreme Lower limit/Lower limit : 0 to 100.0 % O_2		Both 0 (none)	LL=0, LO=0	
	E-2	Contact delay : sec., Hysteresis : % O_2		3 sec, 0.1 % O_2	3sec, 0.1 % O_2	
Time matching, temperature unit assigning, etc.	F-0	Hour-meter setting : Day/Hour, Minute				
	F-1	O_2 concentration averaging time : 1 to 255 hour		1 hour	1 hr	
	F-2	Max./Min.O_2 averaging time : 1 to 255 hour		24 hour	24 hr	
	F-3	Temperature unit specification : °C		°C	0 : °C	
	F-4					
	F-5					
Contact output	G-0	Contact output 1	(See 6.1.7)	NE/F		
	G-1	Contact output 2		NDE/E+C+W		
	G-2	Contact output 3		NDE/H+L		
Contact input	G-3	Contact input 1	P: process gas error alarm, B: Instructions for start of blow-back	R	1 : R	
	G-4	Contact input 2	G: Calibration gas under pressure alarm, R: Instructions for change in measurement range, C: Instructions for start of calibration	R	1 : R	
Communication	H-0	Communication mode : freewheel/handshake		handshake	handshake	
	H-1	Baud rate : 9600 b/s, 4800 b/s, 2400 b/s		4800bps	1 : 48	
Fuel, calculation data	J-0	Types of fuels				
	J-1	Moisture content in exhaust gas : 0 to 5 m^3/kg (m^3)				
	J-2	Theoretical air quantity : 1 to 20 m^3/kg (m^3)				
	J-3	Net calorific value : 0 to 62790 kJ/kg(m^3)				
	J-4	X value ($X=a + b \cdot H_1$)				
	J-5	Absolute humidity of atmosphere : 0 to 1 kg/kg				
	J-6	Temperature of exhaust gas : 0 to 2000 °C				
	J-7	Temperature of atmosphere : –50 to 60 °C				

<Details about Selecting Set Data>

C-0 Span gas concentration

You can set the oxygen concentration for your span gas used for calibration. If the air at the detector installation site is taken in or the instrument air is used as a span gas, set the value at 21 vol% O_2 (i.e., nearly the same oxygen concentration of clean air) by entering “021.00”.

If the air at the installation site is to be taken in but is obviously polluted, check the actual oxygen concentration using a portable oxygen analyzer, etc.

Readout on the message display (Example)

```
C 0  C A L  G A S  C O N C ( % O 2 )
     S P A N  = 0 2 1 . 0 0
```

C-1 Zero gas concentration

You can set the oxygen concentration for the zero gas used for calibration. Set it for the gas charged in the cylinder you are using at present. If the concentration is 1 vol% O_2, for example, then enter “001.00”.

Readout on the message display (Example).

```
C 1  C A L  G A S  C O N C ( % O 2 )
     Z E R O  = 0 0 1 . 0 0
```

C-2 Calibration mode

Select your mode from AUTO (AT), SEMI-AUTO (SEMI) and ONE-TOUCH (TCH). Set the cursor to the corresponding number. The calibration mode presently set is expressed with the number displayed under the function number.

For more details on the operation of each mode, see 6.1.7 “Calibration”.

Readout on the message display (Ex.)

```
C 2  C A L I B R A T I O N  M O D E
2    0 : A T  1 : S E M I  2 : T C H
```

Number of mode presently set.

C-3 Stabilizing time

You can set a waiting period for the time from the completion of the calibration to the beginning of measurements again, in minute units. Set an interval for the time between stopping the flow of the calibration gas and completing the replacement of the calibration gas around the detector sensor with measurement gas. If it is 3 minutes 30 seconds, for example, enter “03.5”.

The operation mode, switched to the maintenance mode (MAINT) during calibration operations, will return to the measurement mode (MEAS).

Readout on the message display (Ex.)

```
C 3  S T A B I L I Z I N G  T I M E
     0 3 . 5 m i n u t e s
```

C-4 Calibration time

You can set a time at which the converter reads the oxygen concentration of a calibration gas (span gas or zero gas). In automatic or semi-automatic calibration mode, set a time (in minutes) from which the converter outputs solenoid valve driving signals (power supply) which causes the calibration gas to flow out. In one-touch calibration, set a permissible maximum interval for the time between when you enter a positive answer (by pressing the key “YES”) in reply to the message “Span (or Zero) valve open Y?” shown in the message display, and when the calibration value is completely read, also in minutes. If it is 5 minutes, for example, enter “05.0 “. When you calibrate a system where no solenoid

valve is used for the calibration gas, you have to operate a valve to get rid of the gas in the meantime, and so on. Take this into account when setting the data.

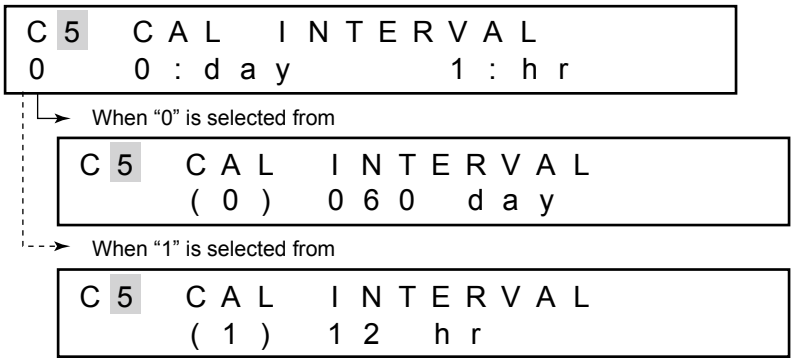
Upon the completion of the calibration time interval, you will see the message, “Span (or Zero) cal good” on the display.

Readout on the message display (Ex.)

C-5 Calibration interval

You can set the interval from the time of starting a calibration to the time of starting the next calibration in automatic calibration. Set in days or hours, the calibration frequency differs according to your process conditions. However, it is normally recommended that intervals of 1 to 3 months (30 to 90 days) be used. If a calibration interval of 60 days is to be set, select “0” from the settable-item selection messages thereby displaying the day-setting message and set 60 days by entering “060”. If you want to set 12 hours, for example, select “1” from the settable-item selection messages and, after the time setting request message is shown, enter 12 hours with “12”.

Readout on the message display (Ex.)



C-6 Calibration start time

You can set the date and time at which the first automatic calibration is to start. If it is 4:30 pm, July 15, 1995, for example, set the date by entering “95/07/15 16:30”.

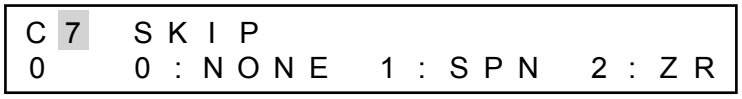
Readout on the message display (Ex.)

C-7 Skip

Calibration is normally performed for both zero and span points. However, either of them may be omitted (but both zero and span points should be calibrated once). In this section, the assignment of this omission is described. If you do not want to omit them any longer, select “0”. For omitting span or zero point, select “1” or “2”, respectively.

These assignments are effective for semi-automatic and automatic calibrations. You cannot omit them in one-touch calibration.

Readout on the message display (Ex.)



D-0 Output range 1

You can set the range of oxygen concentration to correspond to the analog output signal (4 to 20 mA or 0 to 20 mA DC). You can set a free range from 0 to 25 vol% O_2. Also, a partial range is selectable provided the minimum value in the range is 6 vol% O_2, under the condition that the ratio of "maximum: minimum" is "1.3: 1" or greater.

(Note) If the output mode is set to "Logarithm" in function No. D-4, the minimum value of the output range is always "0.1" regardless of this setting.

Readout on the message display (Ex.)

```
D 0  O U T P U T  R A N G E  1
     0 0 0  -  0 5 0  % O 2
```

CAUTION

When the instrument is used in explosion-proof atmospheres, it cannot measure the oxygen concentration where the maximum measured value exceeds 21% vol O_2.

D-1 Output range 2

Output range 2 can be output only when the converter has the functions of "contact input" or "digital communication" by the "range change command". Similar to output range 1, set the oxygen concentration range correspondent to the analog output signal (4 to 20 mA DC or 0 to 20 mA DC). Any range from 0 to 25 vol% O_2 can be set. If the minimum value of a range is 6 vol% O_2 or more, a partial range can be set under conditions where the ratio of the "maximum value to the minimum value" is "1.3 to 1" or more. If selecting a partial range of 10 to 25 vol% O_2, set "010 – 025".

In addition, if the "range selection command" is to be made with a contact input, select Change in measurement range in function Nos. G-3 or G-4. However, if the command is made via digital communications, do not select Change in measurement range. If selected, a command via digital communications cannot be received.

Readout on the message display (Ex.)

```
D 1  O U T P U T  R A N G E  2
     0 1 0  -  0 2 5  % O 2
```

CAUTION

When the instrument is used in explosion-proof atmospheres, it cannot measure the oxygen concentration where the maximum measured value exceeds 21% vol O_2.

D-2 Output signal hold

You assign whether or not analog output signals are in a mode other than measurement mode as, for example, maintenance mode in which calibration or data setting is performed. Assign "0", "1" or "2" for directly outputting the measured value without holding it, outputting the measured value after having held it until immediately before entering a mode other than the measurement mode, or outputting the preset value, respectively.

When "2" is selected, a message for setting a preset value is then displayed, so enter your value from the keyboard. Preset values are in O_2 vol% units. If, for example, you desire 0% (corresponding to 4 mA DC in the case of 4 to 20 mA), select "000".

(Note) The output signal in a state other than normal operation, such as in data setting mode or during warming up, shows the value either for holding the preceding value or for preset holding (where “2” is set), even if “0” is set. If the preset value is not set in the preset hold mode, the preceding value holds.

Readout on the message display (Ex.)

```
D 2   O U T P U T   H O L D
2     0 : N   1 : H L D   2 : P - H L D
```

When “2” is assigned

```
D 2   O U T P U T   H O L D
( 2 ) P R E S E T   H O L D   = 0 0 0 %
```

D-3 Types of output signals

You assign the analog output signals conforming to the specifications of the receiving meter in use. Enter “0” for 4 to 20 mA DC. A 0 to 20 mA current output cannot be set.

Readout on the message display (Ex.)

```
D 3   C U R R E N T   O U T P U T
0     0 : 4 - 2 0 m A   1 : 0 - 2 0 m A
```

D-4 Output signal characteristics

The relationship between the 4 to 20 mA DC analog output signal and oxygen concentration is normally linear. However, you can modify it to logarithmic.

You can set either. For a linear or logarithmic relationship, assign “0” or “1”, respectively.

(Note) For the “relationship between the output current and oxygen concentration “when selecting” log “see the description of function No. A-5 mentioned in subsection 7.2.3.

Readout on the message display (Ex.)

```
D 4     O U T P U T   S C A L E
0       0 : L i n e a r     1 : L o g
```

D-5 Output smoothing constant

If the oxygen concentration of the measurement gas changes suddenly, and you use these measured values directly to control operations, problems (e.g., frequent turning ON/OFF of operations) might occur. To avoid such situations, you introduce a modified time constant into the operation in order to smooth out the signal variations. You can set a time constant of up to 255 seconds, so enter a suitable value from the keyboard. If it is 30 seconds, enter “030”.

Readout on the message display (Ex.)

```
D 5   S I G N A L   D A M P I N G
      0 3 0   s e c
```

D-6 Moisture base in measurement gas

Combustion gases contain moisture created by burning hydrogen in the fuel. If this moisture is removed, the oxygen concentration after removal might be higher than before. You can select whether the oxygen concentration in a wet gas is measured directly, or compensated to a dry-gas value before use. For wet or dry conditions, assign “0” or “1”, respectively.

You can set the moisture content required for the calculation according to Function No. J-1 through J-7.

Readout on the message display (Ex.)

```
D 6   W E T / D R Y   O 2   S E L E C T
0     0 : W E T   1 : D R Y
```

E-0 Setting of extreme high-limit/high-limit alarms

You can set the level(s) of contact output signals for the extreme high-limit and/or high-limit alarms. If, for instance, you want to have an alarm set at an oxygen high-limit of 6.5 vol% O_2 but deactivate the extreme high-limit alarm, enter “000.0” for the extreme high-limit alarm (HH=) and “006.5” for the high-limit alarm (HI=).

You can set these settings related to contact output with Function Nos. G-0 through G-2.

(Note) For alarm value display, see 7.2.2 “Function No. A-0, Analog Bargraph Display”.

Readout on the message display (Ex.)

```
E 0   A L A R M   S E T   P T ( % O 2 )
      H H = 0 0 0 . 0 , H 1 = 0 0 7 . 5
```

E-1 Setting of extreme low-limit/low-limit alarms

You can set the level(s) of contact output signals for the extreme low-limit and/or low-limit alarms. If, for instance, you want to have an alarm set at an oxygen extreme low limit of 2.5% and activate a low-limit alarm of 4.9%, enter “002.5” for the extreme low-limit alarm (LL=) and “004.9” for the low-limit alarm (LO=).

You can set these settings related to contact output with Function Nos. G-0 through G-2.

(Note) For alarm value display, see 7.2.2 “Function No. A-0, Analog Bar-graph Display”.

Readout on the message display (Ex.)

```
E 1   A L A R M   S E T   P T ( % O 2 )
      L L = 0 0 2 . 5 , L O = 0 0 4 . 9
```

E-2 Contact operation of alarm output

When measured values return to a stationary range after leaving the alarm range, it is sometimes desirable for existing alarm output to be reset conditionally instead of being reset immediately. You can set such conditions, i.e., operation delay and hysteresis. The operation delay, once set here, is effective even after measured values shift from the stationary range to the alarm range. Set the operation delay (in “seconds”) and the hysteresis in the oxygen concentration (vol% O_2), respectively.

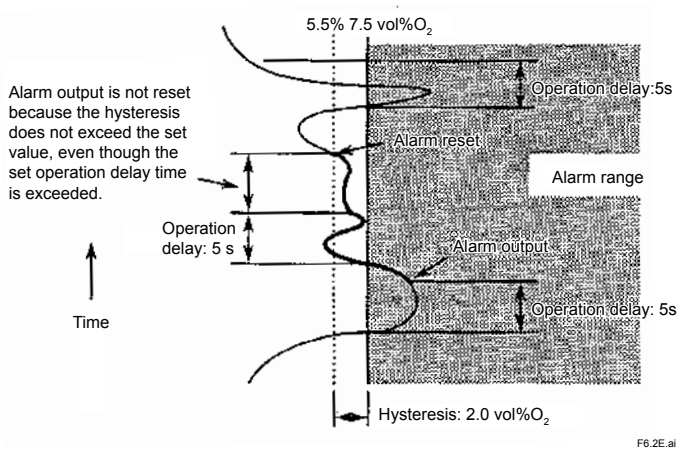
For instance, to set an operation delay of 5 seconds and a hysteresis in the oxygen concentration of 2.0 vol% O_2, enter “005” and “2.0” on the keyboard.

(Note) The operation delay set here is applied to all contact signals selected with function numbers G-0 to G-2.

Readout on the message display (Ex.)

```
E 2   R L   D E L A Y   = 0 0 5 s e c
      R L   H Y S       = 2 . 0 % O 2
```

The alarm output for the example above becomes as follows:


5.5% 7.5 vol%O2
Operation delay:5s
Alarm reset
Alarm range
Alarm output
Operation delay: 5s
Hysteresis: 2.0 vol%O2
Alarm output is not reset because the hysteresis does not exceed the set value, even though the set operation delay time is exceeded.
Operation delay: 5 s
Time
F6.2E.ai

F-0 Adjustment of date and time

Set the clock in this instrument to the present date and time. If the present date/time is April 26, 2006/6:45 pm for instance, enter “06/04/26 18:45” and press the “ENTER” key to activate the date and time.

Readout on the message display (Ex.)

```
F 0   C L O C K   E N T R Y
      0 6 / 0 4 / 2 6   1 8 : 4 5
```

F-1 Mean O_2 concentration calculation time

You can set the time for collecting measured data in order to calculate the mean oxygen concentration (indicated when you access Function No. A-2). Measured data are collected and summarized in 60 second intervals, while averages are calculated every time a datum is collected. And, after the set time expires, the calculated mean value is reset, and the operation of calculating a new mean value begins all over again. If you want to update accumulated data every 24 hours, set this function at “024”. Accumulation of data begins from the time you press the entry key.

(Note) The calculation of the mean value is activated every time a datum is collected. So, the longer the calculation time is extended, the more data which are used in averaging are collected. If you use mean data periodically, you should take notice of this.

Readout on the message display (Ex.)

```
F 1   A V E R A G E   I N T E R V A L
        0 2 4   h r
```

F-2 Time interval for monitoring maximum/minimum O_2

The converter stores the maximum and minimum values of measured oxygen concentrations within a set time period. You can see these values on the message display by accessing Function No. A-1.

You can set the time period for storing these maximum and minimum values. If you want to store them for a week, enter “168” (hr). The storage of data begins when you press the entry key. Stored maximum and minimum values are updated by comparing them with the new data periodically. When the set time expires, the stored values are reset, and new maximum and minimum value storage begins all over again.

Readout on the message display (Ex.)

```
F 2   M A X , M I N   I N T E R V A L
        1 6 8   h r
```

F-3 Setting the temperature unit (°C)

This instrument allows you to set the temperature unit to be displayed in Function Nos. A-4 and B-5 in section 7.2.3.

Readout on the message display (Ex.)

```
F 3   T E M P   U N I T   S E T
  0   0 : ℃
```

Do not set the functions of Nos. F-4 and F-5.

G-0, G-1, G-2 Contact outputs 1, 2, 3

This instrument can freely output any contact signal selected out of 13 specified types. You select this together with the assignment of the relay contact operation (normally energized or deenergized) in Function Nos. G-0, G-1 and G-2.

In the default state, the operation of the relay contact in Function No. G-0 is “normally energized” while that in No. G-1 is “normally energized”. In this state, the contact signals “in entry”, “in calibration” and “in warm-up” are output. At that time, the operation of the relay in Function No. G-2 is “normally deenergized” and outputs the contact signals “high-limit alarm” and “low-limit alarm”.

Readout on the message display (Ex.)

G	0		R	Y	1		C	O	N	T	.	O	U	T	P	U	T		
				1	0	0	0	0	0	0	0	0	0	0	0	1	0		
				: 1	2	3	4	5	6	7	8	9	10	11	12	13	14		

(Note 1)

Digit No. 1: Relay Operation Setting.
Digit Nos. 2 to 14: Section of contact signal to be used (to use=1, Don't use=0)

Digit No. 1)	Relay Operation : Relay operation is selected whether it is normally energized or deenergized. 0: Normally energized(NE) 1: Normally deenergized(NDE)
Digit No. 2)	Error Occurrence : Relay operates when an error (code “E--1” to “E--8”) occurs.
Digit No. 3)	High-high alarm(HH): Relay operates when the high-high limit setpoint set with function No. E-0 is reached. (Note 2)
Digit No. 4)	High Alarm (H): Relay operates when the high limit setpoint set with function No. E-0 is reached. (Note 2)
Digit No. 5)	Low Alarm (L): Relay operates when the low limit setpoint set with function No. E-1 is reached. (Note 2)
Digit No. 6)	Low-low Alarm (LL): Relay operates when the low-low limit setpoint set with function No. E-1 is reached. (Note 2)
Digit No. 7)	Entry (E): Relay operates when the setting mode is set.
Digit No. 8)	In Calibration (C): Relay operates when calibration action is selected.
Digit No. 9)	Renge selection Answerback(R): Relay operates when the selection command is input in a state where the range selection command (R) is set in function No. G-3 or No. 14
Digit No. 10)	In Warming-up (W): Relay operates when the detector is warmed up.
Digit No. 11)	Calibration Gas Pressure Reduction (G): Relay operates when the pressure reduction alarm is input in a state where the calibration gas pressure reduction alarm (G) is set in function No. G-3 or G-4.
Digit No. 12)	Always set 0 (zero) for Digit No.12.
Digit No. 13)	Solenoid Valve Assembly Drive (P): Relay operates when the process gas failure alarm is input in the state where the process gas failure alarm input (P) is set with function No.G-3. (Note 3)
Digit No. 14)	Blowback (B): Relay operates when blowback state command is input in the state where the blowback state command (B) is set with function No. G-3.

(Note 1)
When a function is to be used, it is specified by setting the corresponding digit to 1.
The default status is those shown below.
G-0: (0) 1 0 0 0 0 0 0 0 0 0 0 0 0
G-1: (1) 0 0 0 0 0 1 1 0 1 0 0 0 0
G-2: (1) 0 0 1 1 0 0 0 0 0 0 0 0 0

(Note 2)
The relay is energized corresponding to the operation delay and hysteresis valve set in function No. E-2.

(Note 3)
“Solenoid valve assembly drive” is a function for driving a solenoid valve which supplies purge gas to the detector when gases not yet burned are mixed into the measuring gas. This function can also be applied to the cases where a sensor breakage accident due to condensed water should be prevented by purging the calibration gas tubing at the restart of operation.

On shipment, relay contacts for contact output relays are set as shown below.

Function No. G-0 (Contact output #1) relay contacts: “Break contact” (closed when de-energized)

Function No. G-1 (Contact output #2) relay contacts: “Make contact”

Function No. G-2 (Contact output #3) relay contacts: “Make contact”

The contact type can be changed by re-setting the jumper connector positions on the PCB. If “Break contact” (open when energized) is necessary, change it referring to subsection 6.1.7.

G-3 Contact point input 1

The instrument can accept a total of 2 contact inputs assigned in Functions Nos. G-3 and G-4. You select them from the following 5 types in Function G-3:

0: Calibration gas under pressure alarm (G)

1: Instructions for change in measurement range (R)

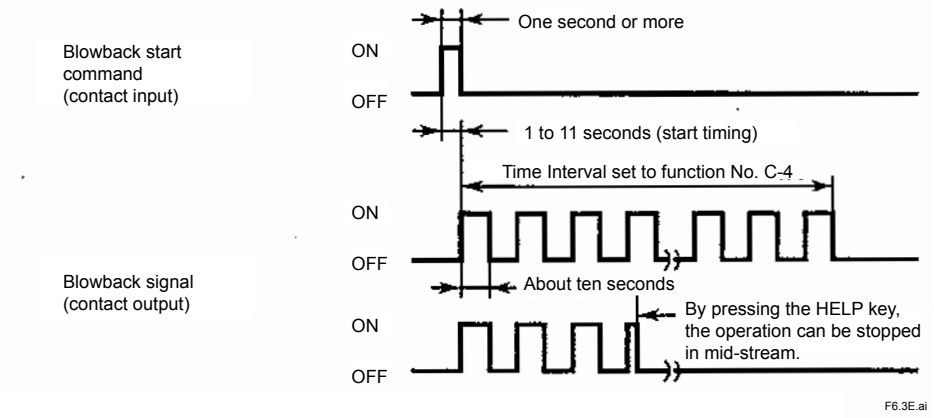
2: Instructions for start of calibration (C)

3: Process gas error alarm (P)

4: Instructions for start of blow-back (B) “see Note 2”

If the process gas error alarm is selected, move the cursor to “3” with the keys. If this error alarm is assigned, the power circuit supplying the detector with power from the converter is turned OFF when the contact signal is received. At the same time, the contact signal for driving the solenoid assembly is output.

(Note 2) The Blowback start command is valid when blowback is specified for function No. G-0 (or G-1 or G-2). Take the blowback start command contact input for more than one second. When the converter receives the blowback start command, it outputs a contact signal which turns ON and OFF about every ten seconds for an interval the same as the “calibration time” set for function No. C-4, starting at 1 to 11 seconds after receiving the command.



(1) Blowback can be stopped with the HELP key.
(2) Blowback is not started during calibration because the calibration-start commands (AUTO, SEMI-AUTO, ONR TOUCH) and calibrating action have priority.
(3) The “blowback signal” time does not include the stabilizing time set for function No. C-3.
(4) The analog output at the blowback operation becomes the mode specified for function No. D-2 (Non-Hold, Hold, or Preset Hold).

Readout on the message display (Ex.)

```
G 3   R Y 1   C O N T   I N P U T
3     0 : G   1 : R   2 : C   3 : P   4 : B
```

G-4 Contact input 2

In Function No. G-4, select the contact input signal from the following 3 types:

0: Calibration gas under pressure alarm (G)

1: Instructions for change in measurement range (R)

2: Instructions for start of calibration (C)

If the measurement range change instruction is assigned, move the cursor with the keys to “2”.

Readout on the message display (Ex.)

```
G 4   R Y 2   C O N T   I N P U T
2     0 : G   1 : R   2 : C
```

H-0 Communication mode

The communication mode should be specified only when digital communications are achieved. When “1” is specified, the message “Set ZA8C converter channel number (CH=)” appears. So enter channel numbers 1 through 8 for the individual converters.

(Note) When an RS-422-A communication interface is used, up to 8 converters can be connected to one computer. Channel numbers are used to distinguish them from converters, so set channel numbers which are different from the converter numbers.

Readout on the message display (Ex.)

```
H 0   C O M M   M O D E
0     0 : F R E E   1 : H A N D
```

When “1” is assigned

```
H 0   C O M M   M O D E
( 0 ) H A N D   S H A K E : C H = 3
```

H-1 Baud rate (data communication rate) assignment

You assign here operating digital communications. For a data communication rate of 9600 bps or 4800 bps, enter “0” or “1”, respectively. For 2400 bps, select “2” from the keyboard.

Readout on the message display (Ex.)

```
H 1   B A U D   R A T E   ( b p s )
1     0 : 9 6   1 : 4 8   2 : 2 4
```

(Note) DISP Key

```
H 1   B A U D   R A T E
( 0 ) 9 6 0 0   B i t s / s e c
```

J-0 Types of fuels

You can select a type of fuel for obtaining the concentration of oxygen in a dry gas. Select and assign in Function No. J-0 what fuel you are using from the following 5 types;

0: Heavy oil A (A)

1: Heavy oil B (B)

2: Heavy oil C (C)

3: Gas (G)

4: Coal (X)

If your oil in use is heavy oil C, move the cursor to “2” with the keys.

Readout on the message display (Ex.)

```
J 0   F U E L   G R A D E
2     0 : A  1 : B  2 : C  3 : G  4 : X
```

J-1 Moisture content in exhaust gas

You can set the amount of moisture contained in the combustion exhaust gas of the fuel used in the measurement process (in terms of N m^3/kg or m^3/m^3 in proportion to the unit volume of the fuel). Look up the setting value from Table 6.2. If there are no relevant descriptions for your fuel, calculate the value using the formula shown on pages 6-18.

If the moisture content is 1.27 N m^3/kg, for example, enter “01.27”.

Readout on the message display (Ex.)

```
J 1   H 2 O   I N   F U E L
      0 1 . 2 7   m 3 / k g ( m 3 )
```

J-2 Theoretical air quantity

You can set the theoretical air quantity required for the fuel used in the measurement process to ignite (N m^3/kg or m^3/m^3). Look up the setting value from Table 6.2. If there are no relevant descriptions for your fuel, calculate the value using the formula shown on Pages 6-18.

If the theoretical air quantity is 10.7 N m^3/kg, enter “10.70”.

Readout on the message display (Ex.)

```
J 2   T H E O R I T I C A L   A I R
      1 0 . 7 0   m 3 / k g ( m 3 )
```

J-3 Net calorific value

You can set the net calorific value of the fuel used in the measurement process (in kJ/kg or kJ/m^3). Look up the setting value from Table 6.2. If there are no relevant descriptions for your fuel, calculate the value using the formula shown on Pages 6-18.

If the net calorific value is 41274 kJ/kg, enter “41274”.

Readout on the message display (Ex.)

```
J 3   NET  CALORIFIC  VAL
      41274  kJ/kg(m3)
```

J-4 X value ($X=a + b \cdot H_1$)

The X value (N m^3/kg or m^3/m^3) is the coefficient provided with each fuel. Look up the x value of the fuel used from Table 6.2. If there are no relevant descriptions for your fuel, calculate the value using the formula shown on Pages 6-18.

If the X value is 0.773 (m^3/kg), for instance, round off the value to the second decimal place and enter “00.77”.

Readout on the message display (Ex.)

```
J 4   VALUE  OF  X
      00.77  m3/kg(m3)
```

J-5 Absolute humidity of atmosphere

You can set the absolute humidity of the atmosphere used in igniting (moisture: kg/dry air: kg). If the absolute humidity is 0.021 kg/kg, enter “0.021”.

For your reference, a graph for determining absolute humidity by the temperature indications of a psychrometer is shown in Figure 6.3. It is a little inferior in accuracy. If the exact humidity is required, determine the value by referring to References such as JIS B8222, “Heat Balancing of Boilers for Land Use.”

Readout on the message display (Ex.)

```
J 5   ABS  HMD  OF  AIR
      0.0210  kg/kg
```

J-6 Temperature of exhaust gas

You can set the temperature of the exhaust gas in the actual combustion process (°C).

If the temperature of the exhaust gas is 450°C, enter “0450”.

Readout on the message display (Ex.)

```
J 6   FUEL  GAS  TEMP
        0450  °C
```

J-7 Temperature of atmosphere

You can set the temperature of the atmosphere taken in for igniting (°C). Measure the temperature of the atmosphere at a place as close to the air intake port as possible.

If the temperature is minus 1°C, for instance, enter “−001”. You can alternately display plus and minus signs by pressing the increase key.

Readout on the message display (Ex.)

```
J 7   AMB  AIR  TEMP
        –001  °C
```

Table 6.2 Various Values of Fuels

● Liquid fuels

J - 2: Theoretical air qty → ↓ J-4:X value → ↓

Type \ Fuel properties			Specific weight kg/l	Chemical components (% by weight) C	h	O	N	S	ω	Ash	Heat value kJ/kg High	Low	Theoretical combustion N m³/kg	Combustion gas qty N m³/kg CO_2	H_2O	SO_2	N_2	Total	X value
Kerosene			0.78~0.83	85.7	14.0	—	—	0.5	0.0	0.0	46465	43535	11.4	1.59	1.56	0.00	9.02	12.17	0.96
Light oil			0.81~0.84	85.6	13.2	—	—	1.2	0.0	0.0	45879	43032	11.2	1.59	1.47	0.00	8.87	11.93	0.91
A	Heavy oil class 1	No.1	0.85~0.88	85.9	12.0	0.7	0.5	0.5	0.3	0.05	45544	42739	10.9	1.60	1.34	0.00	8.61	11.55	0.89
		No.2	0.83~0.89	84.6	11.8	0.7	0.5	2.0	0.3	0.05	45125	42320	10.8	1.58	1.32	0.01	8.53	11.44	0.86
B	Heavy oil class 2		0.90~0.93	84.5	11.3	0.4	0.4	3.0	0.4	0.05	43827	41274	10.7	1.58	1.27	0.02	8.44	11.31	0.77
C	Heavy oil class 3	No.I	0.93~0.95	86.1	10.9	0.5	0.4	1.5	0.5	0.1	43953	41441	10.7	1.61	1.22	0.01	8.43	11.27	0.79
		No.2	0.94~0.96	84.4	10.7	0.5	0.4	3.5	0.5	0.1	43116	40646	10.5	1.58	1.20	0.02	8.32	11.12	0.72
		No. 3	0.92~1.00	86.1	10.9	0.5	0.4	1.5	0.6	0.1	43660	41190	10.7	1.61	1.22	0.01	8.43	11.27	0.77
		No.4	0.94~0.97	83.0	10.5	0.5	0.4	3.5	2.0	0.1	43032	40604	10.3	1.55	1.18	0.02	8.18	10.93	0.72

J - 3: Net calorific value of fuel in ↑ — J -1: Moisture content in exhaust gas ↑

● Gas fuels

J - 2: Theoretical air qty → ↓ J-4:X value → ↓

Type \ Fuel properties	Specific weight kg/Nm³	Chemical components (% by weight) CO	H_2	CO_2	CH_4	C_mH_n	O_2	N_2	Heat value kJ/Nm³ High	Low	Theoretical combustion N m³/m³	Combustion gas qty N m³/m³ CO_2	H_2O		N_2	Total	X value
Coke oven gas	0.544	9.0	50.5	2.6	25.9	3.9	0.1	8.0	20428	18209	4.455	0.45	1.10		3.60	5.15	0.46
Blest furnace gas	1.369	25.0	2.0	20.0	—	—	—	53.0	3391	3349	0.603	0.45	0.02		1.01	1.48	0.08
Natural gas	0.796	—	—	2.0	88.4	3.2	1.6	4.2	37883	34074	9.015	0.98	1.88		7.17	10.03	0.86
Propane	2.030		C_3H_8 90% , C_4H_{10} 10%						102055	93976	24.63	3.10	4.10		19.5	26.7	2.36
Butane	2.530		C_3H_8 10% , C_4H_{10} 90%						125496	115868	30.37	3.90	4.90		24.0	32.8	2.91
(Gases)			(Molecular Formula)														
Oxygen	1.43		O_2						—	—	—	—	—		—	—	—
Nitrogen	1.25		N_2						—	—	—	—	—		—	—	—
Hydrogen	0.09		H_2						12767	10758	2.390	—	1.0		1.89	2.89	0.27
Carbon monoxide	1.25		CO						12642	12642	2.390	1.0	—		1.89	2.89	0.32
Carbon dioxide	1.96		CO_2						—	—	—	—	—		—	—	—
Methane	0.72		CH_4						39750	35820	9.570	1.0	2.0		7.57	10.6	0.90
Ethane	1.34		C_2H_6						69638	63744	16.74	2.0	3.0		13.2	18.2	1.60
Ethylene	1.25		C_2H_4						62991	59060	14.35	2.0	2.0		11.4	15.4	1.48
Propane	1.97		C_3H_8						99070	91255	23.91	3.0	4.0		18.9	25.9	2.29
Butane	2.59		C_4H_{10}						128452	118623	31.09	4.0	5.0		24.6	33.6	2.98

J - 3: Net calorific value of fuel in ↑ — J -1: Moisture content in exhaust gas ↑

<Calculation Formulae>

If you use a fuel not described in Table 6.2, calculate the set values for Function Nos. J -1 to J - 4 using the following formulae:

- **Liquid fuels**

  Moisture content in exhaust gas = 1 /100 {1.24 (9 h + ω)} [m^3/kg]

  Theoretical air quantity= 12.38/10000 × H_1 - 1.36 [m^3/kg]

  Net calorific value = H_1

  X value = 3.37/10000 × H_x - 2.55 [m^3/kg]

  Where, H_1: Net calorific value of fuel

  h: Hydrogen in fuel (% by weight)

  ω: Moisture content in fuel (% by weight)

  H_x: Same as H_1

- **Gas fuels**

  Moisture content in exhaust gas= 1 /100 {(h_2) + ½ Σ_y (C_x h_y) + ω} [m^3/m^3]

  Theoretical air quantity = 11.2 × H_1/10000 [m^3/m^3]

  Net calorific value = H_1

  X value = 1.05/10000 × H_x [m^3/m^3]

  Where, H_1: Net calorific value of fuel

  h: Hydrogen in fuel (% by weight)

  ω: Moisture content in fuel (% by weight)

  H_x: Same as H_1

- **Solid fuels**

  Moisture content in exhaust gas= 1 /100 {1.24 (9h + ω)} [m^3/kg]

  Theoretical air quantity = 1.01×H_1/1000 + 0.56 [m^3/kg]

  Net calorific value = H_1=H_h-5.9 (9h+ω) [kcal/kg]

  X value = 1.11 - (0.106/1000) × H_x [m^3/m^3]

  Where, ω : Total moisture content during use (% by weight)

  h : Hydrogen content (% by weight)

  Mean hydrogen content of domestic coa (moisture-/ash-free) is 5.7%.

  Therefore, h is approximated by the following formula:

  $$h = 5.7 \times [\{100 - (\omega + \alpha)\}/100] \times (100 - \omega)/(100 - \omega_1)$$

  Where, α: Ash content [%]

  ω_1: Moisture content based on industrial analyses (constant - humidity base) [%]

  H_h : High heat value of fuel [kJ/kg]

  H_1 : Low heat value of fuel [kJ/kg]

  H_x : Same as H_1

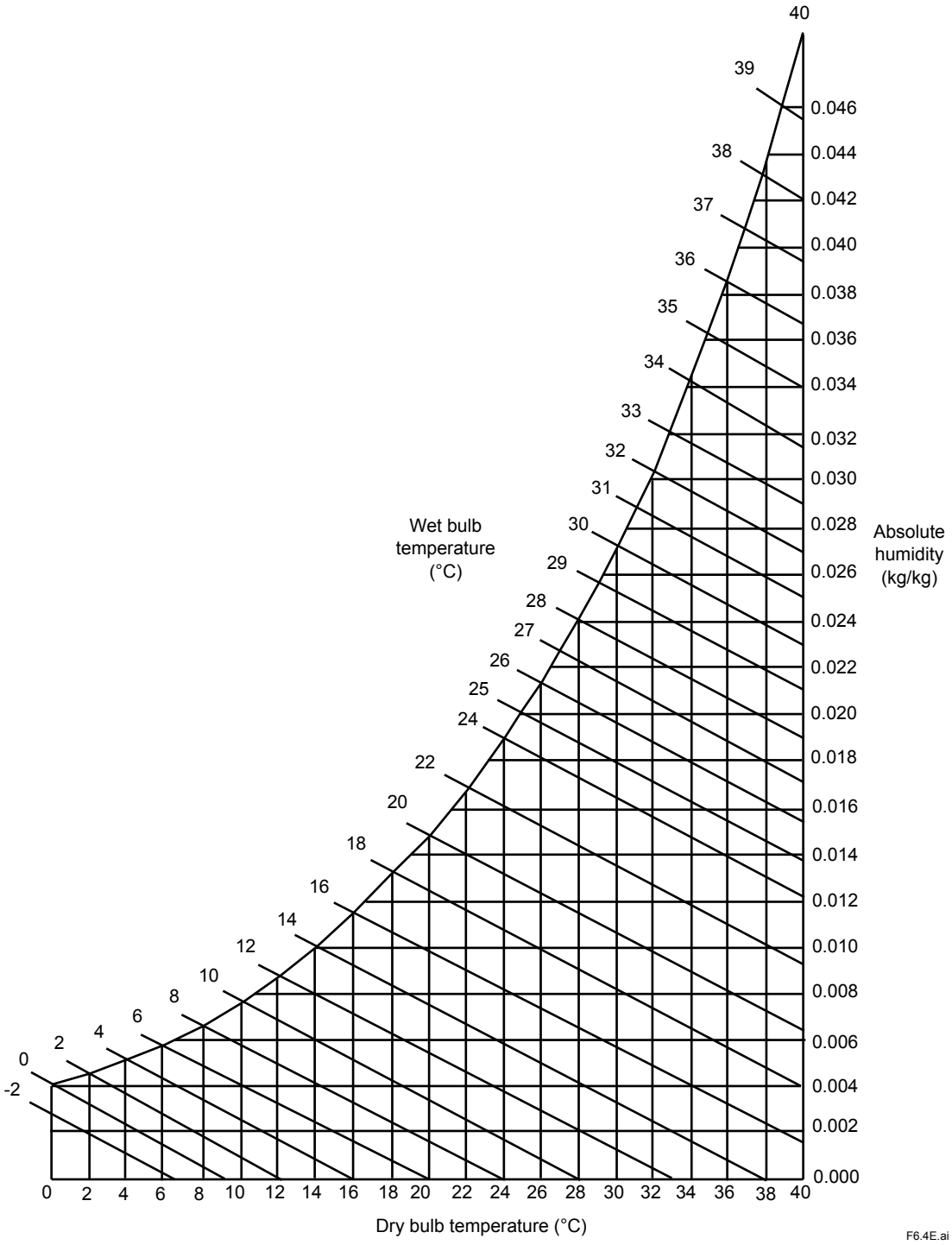


Figure 6.3 Absolute Humidity of Air

6.1.7 Set of Relay Contacts for Contact Output

CAUTION

Never open the cover of the converter before turning off the power source.

Contact status (Normally Open or Normally Closed) of the contact outputs selecting applications with function No. G-0, G-1 or G-2 is determined by the selected relay operation (normally energized or de-energized) and types of relay contact (”make” contact or “break” contact).

(Note) ”NO” of the contact status means the contact operating status where the contact is “closed” when a contact signal is output (NC is its inversion). “Make” contact in the types of relay contact means the contact which is closed when the relay coil is energized.

Table 6.3 Contact States Classified with Relay Operation and Types of Contact

Relay Operation	Type of Relay Contacts	Contact Status		
		When Contact Signal is Output	Normal Condition	Power OFF
Normally energized	Break contact (shortcircuiting jumpers 1 and 2)	[Closed]	[Open]	[Closed]
	Make contact (shortcircuiting jumpers 2 and 3)	[Open]	[Closed]	[Open]
Normally de-energized	Break contact (shortcircuiting jumpers 1 and 2)	[Open]	[Closed]	[Closed]
	Make contact (shortcircuiting jumpers 2 and 3)	[Closed]	[Open]	[Open]

On shipment, the relays are set as shown below.

Function No. G-0 (Contact output #1, Contact status NO):
Normally energized, Break contact

Function No. G-1 (Contact output #2, Contact status NO):
Normally de-energized, Make contact

Function No. G-2 (Contact output #3, Contact status NO):
Normally de-energized, Make contact

If the type of contact is necessary to be changed, do it in the following procedure. The relay operation can be set to function No. G-0, No. G-1, or No. G-2 with key operation.

At that time, carry out the changing work after the converter was moved to nonhazardous area, such as a control room.

(1) Remove the converter cover and the printed circuit board cover. The CPU Assy (printed circuit board Assy) appears as shown in Figure 6.4.

(2) Set the corresponding jumper connector (CN5, CN6, or CN7) position on the CPU Assy again and change the type of contact. For obtaining a make contact, set the jumper connector to pins 2 and 3, while for obtaining a break contact, set the jumper connector to pins 1 and 2. When the set work has been done, restore the PCB cover and turn on the power switch.

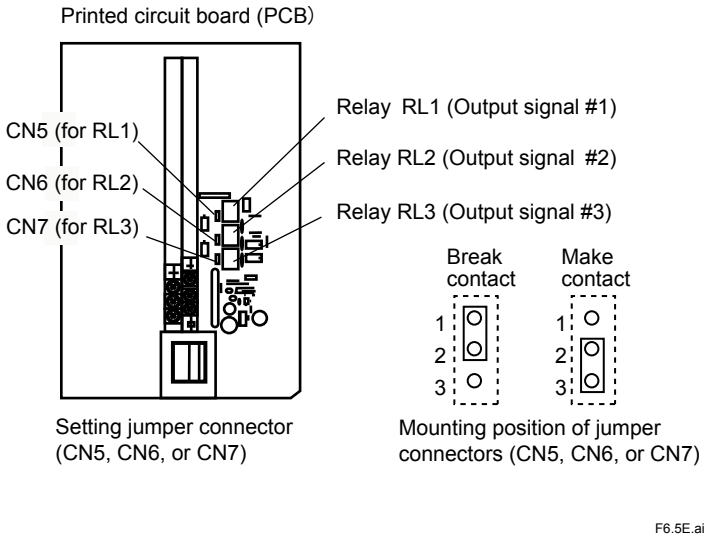


Figure 6.4 Setting Position of Jumper Connector and Setting Method

6.1.8 Supplying Pressure to Ejector

(1) After the proper temperature is reached, the LED indicates the gas concentration (about 21% of span) when the instrument air is flowing. Supply air to the main ejector 30 minutes after the power is applied to the converter. Set the ejector supply pressure so that a pressure of 300 to 500 ml/min is suctioned in accordance with the characteristic curves.

* If the furnace pressure is around atmospheric pressure, set the supply pressure of 20 kPa.

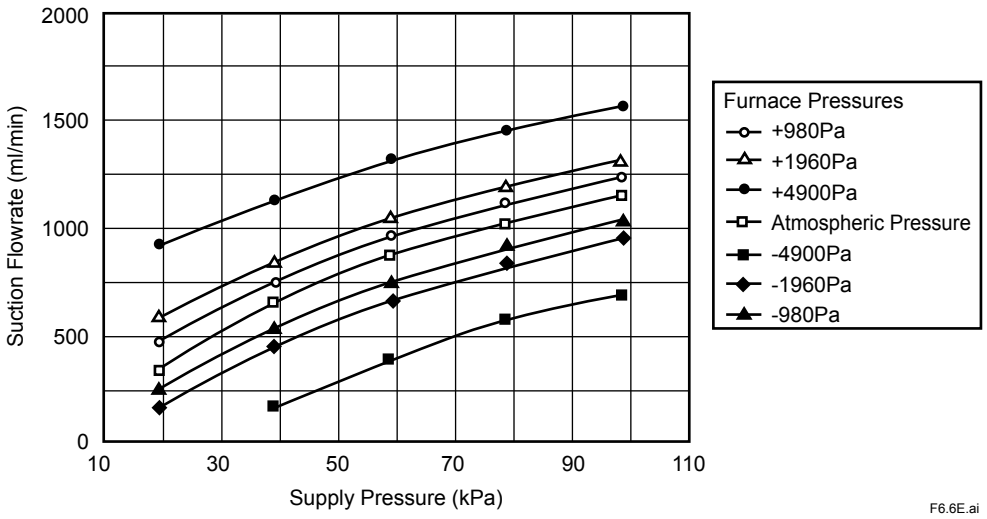


Figure 6.5 Supply Pressure to Suction Flowrate Characteristics in Main Ejector for Detector

(2) When the probe adaptor is used, supply air to the auxiliary ejector. The probe adaptor inner pressure is the same as the furnace pressure independent of the auxiliary ejector suction pressure. For the supply pressure to the auxiliary ejector for the probe adaptor, set the supply pressure so that a suction flowrate of about 20 to 30 l/min is attained.
However, if the probe adaptor's surface temperature exceeds 200°C, or if dust causes the ejector to clog, reduce the suction flowrate.

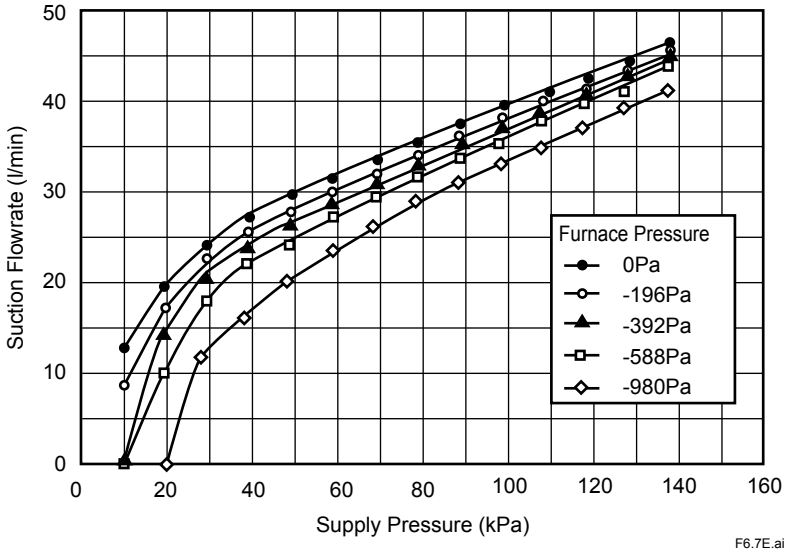


Figure 6.6 Supply Pressure to Suction Flowrate Characteristics in Auxiliary Ejector for Probe Adaptor

6.1.9 Calibration

The calibration of this instrument is carried out by matching either the zero gas or the span gas, or either the oxygen concentration of the zero gas or of the span gas with the measured value of the relevant calibration gas. The reference oxygen concentration at that time is already read into the memory in the converter. The converter detects the deviation of the measured result from this value and automatically corrects it.

The following 3 methods of calibration are available; further calibrations can be carried out periodically or occasionally, and the calibration gas for these later calibrations can be automatically or manually introduced. You can select any of these methods by registering it in the converter.

(1) Automatic calibration

A calibration operation begins when you set the calibration start time and the calibration frequency, and then press the key (or enter an external contact signal) to begin. All operations related to calibration (e.g., calibration time, opening / closing of the solenoid valve and sequence) are automatically activated based on the data set in the converter.

Automatic calibration is applicable to a system corresponding to System 3 or 4.

(2) Semi-automatic calibration

In this mode, calibration begins only when the converter is operated with the keys or receives starting instructions from a contact signal through an external circuit. The other details are the same as those for “automatic calibration”.

This mode is applicable also to a system corresponding to System 3 or 4.

(3) One-touch calibration

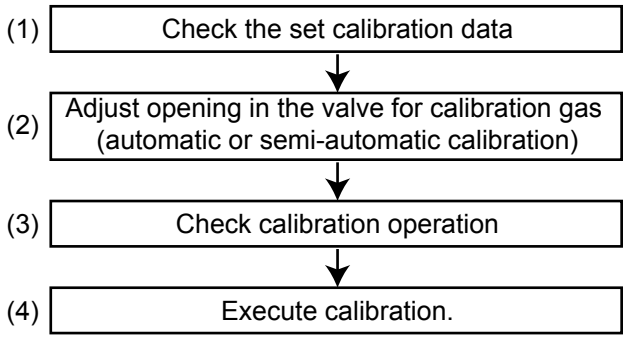
In this mode, operate keys to send the calibration gas or for other procedures depending on the readout on the message display on the converter after you have given the calibration start instructions (in the same way as for semi-automatic calibration). Other calibration operations are automatically processed by the converter.

One-touch calibration is applicable to a system corresponding to System 1 or 2.

You can begin calibration as described above. For more details on calibration, see Chapter 8

"Calibration". The following description mainly explains how to prepare for calibration.

- **Preparation for calibration**



<Checking the set calibration data>

Sequentially display the data from Codes C-0 to C-7 on the message display of the converter and check for errors in the set data (e.g., the selected calibration method and the concentration of calibration gas).

<Checking the calibration operation>

Carry out calibration and check for normal operation. Begin calibration by pressing the key "CAL" on the converter. For the operation procedures of one-touch calibration, see Chapter 8.

If you have trouble when you monitor serial operations to the end of calibration, immediately remedy the problem by, for example, changing set data, etc.

(Note) If the error code "E--5" or "E--6" is shown in the data display, make the correction according to Chapter 10.

<Executing calibration>

If you changed set data previously (in checking the calibration operation), you have to calibrate once again by checking for normal operation. Before beginning automatic calibration, check that the correct time is set in the converter and, after stationary operation (see section 6.2) begins, set the time for the first execution.

6.1.10 Checking Functional Operations

If you have some ongoing instrument operations which need to be checked before beginning stationary operation, check these operations according to the method suited to individual processes. It is recommended that you check safety functions, e.g., the process gas error alarm, for normal operation beforehand.

6.2 Stationary Operation

6.2.1 Collection of Control Data

You can display "maximum/minimum O_2 concentration" of function No. A-1 or "mean O_2 concentration" of A-2 on the message display. However, you cannot use it as an output signal. If you have to control them, read the value at a time as constant as possible for recording.

6.2.2 Troubleshooting

If an error occurs:

(1) A "FAIL" lamp on the converter status display lights us;

(2) An error code appears in the data display area;

and,

(3) Error messages appear in the message display area.

Every time an error occurs, immediately correct it according to the instructions in Chapter 10. The following error codes are operable:

Table 6.4 Error Codes, Details and Status

Error code	Error detail	Error status
E - - 1	Sensor (cell) error	Goes into fail mode, automatically turning OFF the power supply to the detector heater.
E - - 2	Sensor temp “LOW”	Goes into fail mode, automatically turning OFF the power supply to the detector heater.
E - - 3	Sensor temp “HIGH”	Goes into fail mode, automatically turning OFF the power supply to the detector heater.
E - - 4	A/D (Analog circuit) error	Goes into fail mode, automatically turning OFF the power supply to the detector heater.
E - - 5	Calibration value “ZERO”	(Displayed during calibration) the present zero point calibration value is not effected.
E - - 6	Calibration value “SPAN”	(Displayed during calibration) the present span calibration value is not effected.
E - - 7	Start power stability time over	(Displayed during calibration) the present calibration value is not effected.
E - - 8	ROM, RAM error	Goes into fail mode, automatically turning OFF the power supply to the detector heater.
□□□□ (Display erased)	Digital circuit error power failure	Goes into fail mode, automatically turning OFF the power supply to the detector heater. (Displayed upon restart after remedying the power failure) Data values default

(Note) E - - 5, E - - 6, or E - - 7 is displayed alternately with the O_2 concentration.

6.2.3 Checking Operating Conditions

In order to maintain normal operating conditions, determine which items are to be inspected periodically, and check them regularly for errors.

Items recommended for periodic inspections are as follows for your reference. For maintaining or recovering performance, see Chapter 9.

Table 6.5 Example of Items for Periodic Inspection

Inspection item	Purpose & detail of inspection	Inspection interval
Complete closing of calibration gas inlet	To prevent condensation which may break sensor. Check for a complete closing of needle valve.	1 to 7 days
Set flow rate of flow setting unit	Check that flow is about 300 ml/min. for both the reference & calibration gases, for correctly measured and calibrated values.	1 to 7 days
Cell voltage (Function No. A - 3)	To know the extent of deterioration of the sensor (cell). Compare the displayed value with theoretical one.	1 to 2 weeks
Pressure in the calibration gas cylinder	To determine the intervals between replacement of calibration gas (zero gas) cylinders. Specify min. pressure and check for highter pressure.	1 to 2 weeks
Set value of oxygen conc. for calibration gas (zero)	To obtain a correct calibrated value. Check for complete setting of oxygen conc. in the calibration gas (zero) in use.	Upon replacement, etc.
Digital circuit error power failure	To determine the intervals between replacement of purge gas cylinders. Determine min. pressure and check for highter pressure.	1 to 2 weeks
Air supply pressure for main and auxiliary ejectors	For correct measurements, check that the air supply pressure set in Section 6.1.8 does not change.	1 to 2 weeks
Steam supply pressure	For heat insulation by steam, check that the supply pressure is kept at the pressure required.	1 to 2 weeks

6.2.4 Stopping and Restarting Operations

< Operation stoppage >

Before stopping operations, it is important for you not to make the detector sensor inoperable.

If you stop the operation of the zirconia oxygen analyzer at the same time as the boiler or furnace, etc., condensation forms in the sensor and dust adheres to it. If you restart operations with the sensor in this state, as it heats up to 750°C, it causes dust to accumulate which significantly deteriorates its performance. In an extreme case with a lot of condensation, the analyzer may break. To prevent such an occurrence, you have to take the following steps to stop the equipment:

(1) Keep the power supply to the analyzer ON as long as possible. If this is impossible, remove the detector.

(2) If both of the above are impossible, keep air flowing into the calibration gas piping at a rate of about 1000 ml/min. Stop supplying air to the main and auxiliary ejectors.

CAUTION

The flame arrester section (electric or steam heat-insulation section) and the detector surface are extremely hot immediately after turning off the power. If the detector is removed or maintenance is required, never touch these sections immediately after turning off the power. The probe adaptor is also extremely hot immediately after stopping the auxiliary ejector. Special care must also be taken as given above.

<Operation restart>

If none of the above precautions for stopping operations can be done, supply air into the calibration gas piping for 5 to 10 minutes at a rate of about 600 ± 60 ml/min.

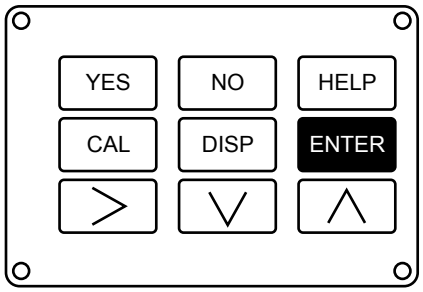
After stopping operations for a long period of time, set the necessary data again (see Table 6.1).

- Ejector air supply pressure: Check that it is set to the specified supply pressure.
- Steam supply pressure: Supply sufficient steam pressure for heat insulation.

7. Operating Keys and Display of Converter

In this Chapter, the operating keys on the operation panel of the converter and the indication on the display unit are described.

7.1 Operating Keys



F7.1E.ai

7.1.1 Types and Functions of Operating Keys

There are 9 seat keys on the operation panel of the converter. You can select an operation mode (measurement mode or maintenance mode), register temporary data, display various measurements or calculated data using these 9 keys. To operate the keys, press the center of each key.

(Note) Operation mode
- Measurement mode
- Maintenance mode
  - Calibration mode (in which calibration is activated)
  - Setting mode (in which set data is checked or entered)
  - Fail mode (in which a fail error occurs)

Table 7.1 Types, Functions and Applications of Operating Keys

Key	Name	Functions, applications
YES	Interactive key (yes)	Used for replying “yes” to an inquiry (Y/N ?).
NO	Interactive key (no)	Used for replying “no” to an inquiry (Y/N ?).
HELP	Sub-message display key Calibration stop key	Used for displaying sub-messages. Used for suspending calibration.
CAL	Calibration start key	Used for issuing start instructions in one-touch or semi-automatic calibration.
DISP	Measurement mode select key. Calibration data display key.	Used for returning the mode from the setting mode, etc. to an analog bar display (measurement mode). Used for monitoring various data during calibration.
ENTER	Entry key Setting-mode select key	Used for registering data in setting mode. Used for changing from the measurement mode to the setting mode.
>	Cursor key Message COS key	Used for moving the cursor to the number or letter to be changed or registered. Used for the display continuation of a message on 2 or more
∧	Number increase key No. forward key	Used for increasing a number on the cursor. Used for changing from one Function No. to the next
∨	Number decrease key No. backward key	Used for decreasing a number on the cursor. Used for returning to one Function No. from another.

7.1.2 Examples of Applications of the Operating Keys

This section describes how to operate the keys with the following examples of operations. For displays, see 7.2.

(1) Changeover from the measurement mode to the setting mode

(2) Reply to inquiry

(3) Entering the password

(4) Selection of Function No. (Selection of number)

(5) Selection of Function No. (Selection of group symbol)

(6) Entering the setting data (Selection of setting details)

(7) Entering the setting data (Input of data values)

(8) Changeover from the setting mode to the measurement mode

(9) Changing displayed data

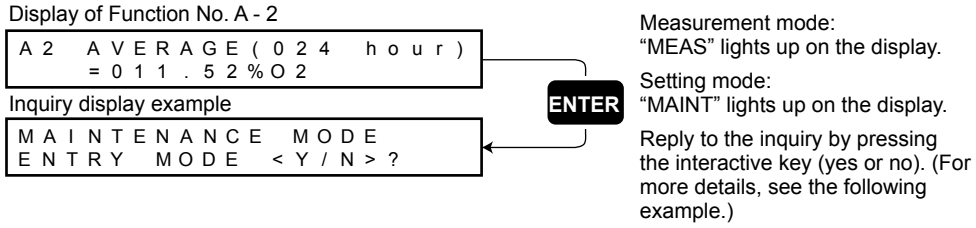
(10) Calibration start or suspension instructions

(11) Displaying the data values in the calibration mode

(1) Changeover from the measurement mode to the setting mode

Used as the setting mode selection key (entry key).

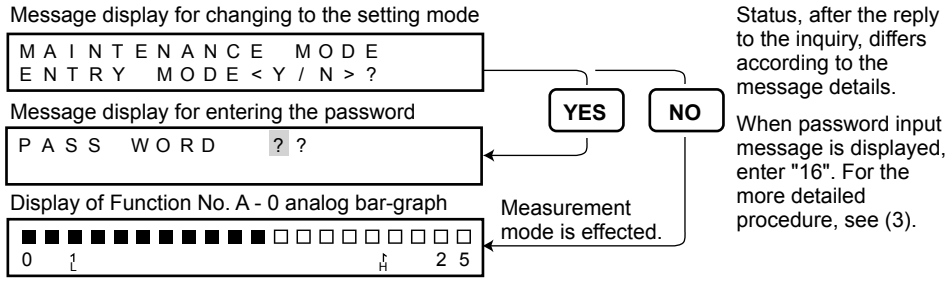
- **Exanoke for changing over from the display of Function No. A-2 to the setting mode**


Display of Function No. A - 2
A 2 AVERAGE (0 2 4 hour)
= 0 1 1 . 5 2 %O 2
Inquiry display example
MAINTENANCE MODE
ENTRY MODE <Y/N>?
ENTER
Measurement mode:
"MEAS" lights up on the display.
Setting mode:
"MAINT" lights up on the display.
Reply to the inquiry by pressing the interactive key (yes or no). (For more details, see the following example.)

(2) Reply to inquiry

Use an interactive key ("YES" or "NO" key).

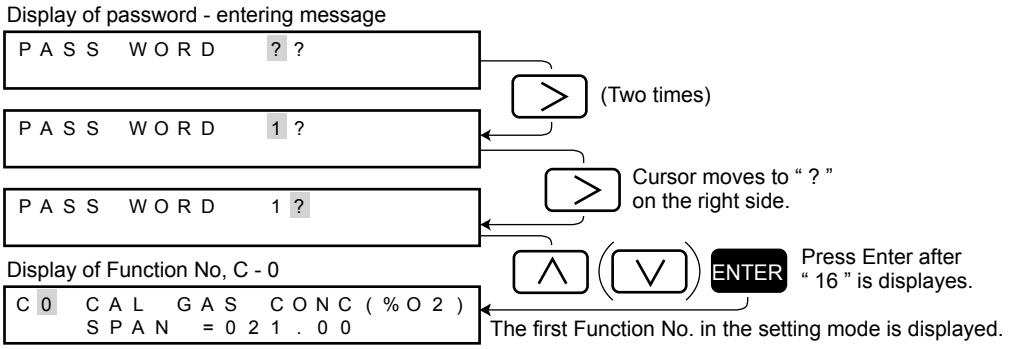
- **Example of replying to the message when changing to the setting mode**


Message display for changing to the setting mode
MAINTENANCE MODE
ENTRY MODE <Y/N>?
Message display for entering the password
PASS WORD ??
Display of Function No. A - 0 analog bar-graph
0 L H 25
YES
NO
Measurement mode is effected.
Status, after the reply to the inquiry, differs according to the message details.
When password input message is displayed, enter "16". For the more detailed procedure, see (3).

(3) Entering the password (16)

To assign a function in the setting mode, you have to enter the password. The password is "16", so enter this number. To do so, use the number increase / decrease key, cursor movement key, and the entry key.

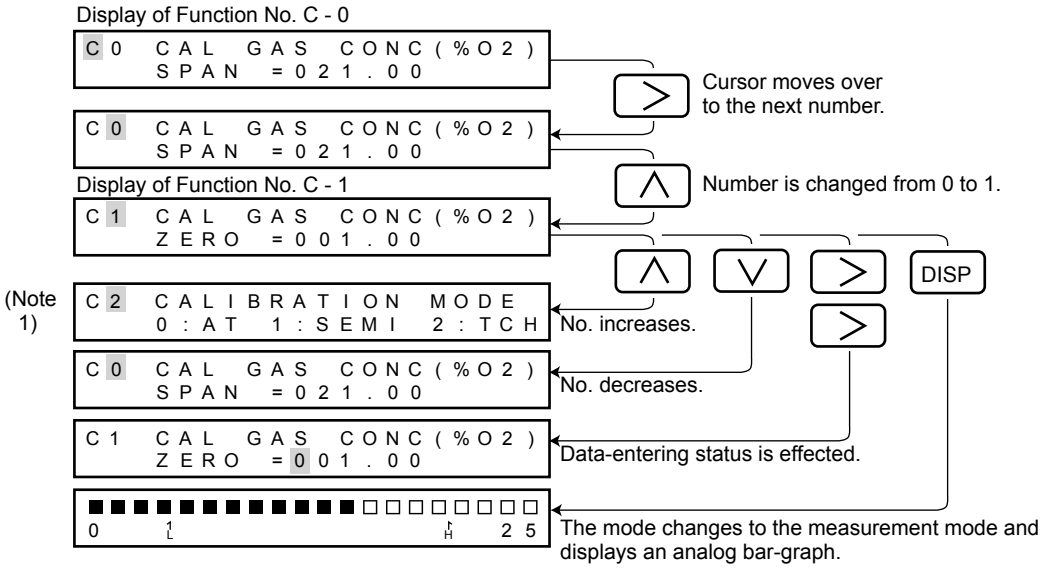
- **Entering the password for setting (checking) temporary data**


Display of password - entering message
P A S S W O R D ? ?
(Two times)
P A S S W O R D 1 ?
Cursor moves to " ? " on the right side.
P A S S W O R D 1 ?
ENTER
Press Enter after " 16 " is displayes.
Display of Function No, C - 0
C 0 C A L G A S C O N C (% O 2)
S P A N = 0 2 1 . 0 0
The first Function No. in the setting mode is displayed.

(4) Selection of Function No. (selection of number)

The number increase key, number decrease key and the cursor key are used.

- **Display of Function No. C-0**

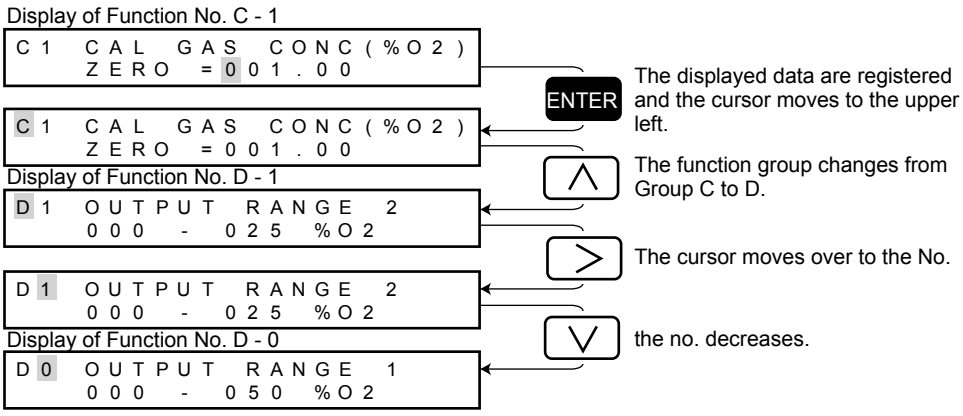

Display of Function No. C - 0
C 0 C A L G A S C O N C (% O 2)
S P A N = 0 2 1 . 0 0
Cursor moves over to the next number.
C 0 C A L G A S C O N C (% O 2)
S P A N = 0 2 1 . 0 0
Display of Function No. C - 1
Number is changed from 0 to 1.
C 1 C A L G A S C O N C (% O 2)
Z E R O = 0 0 1 . 0 0
DISP
(Note 1)
C 2 C A L I B R A T I O N M O D E
0 : A T 1 : S E M I 2 : T C H
No. increases.
C 0 C A L G A S C O N C (% O 2)
S P A N = 0 2 1 . 0 0
No. decreases.
C 1 C A L G A S C O N C (% O 2)
Z E R O = 0 0 1 . 0 0
Data-entering status is effected.
0 L H 2 5
The mode changes to the measurement mode and displays an analog bar-graph.

(Note 1) If the entry key "ENTER" is pressed when the cursor resids in a function No. position, note that "0: AT (automatic calibration)" is automatically set as the calibration mode.

(5) Selection of Function No. (selection of group symbol)

Use the number increase key, number decrease key, entry key, etc. Which keys you use depend on the present state you are in (i.e., the operation mode and the position of the cursor).

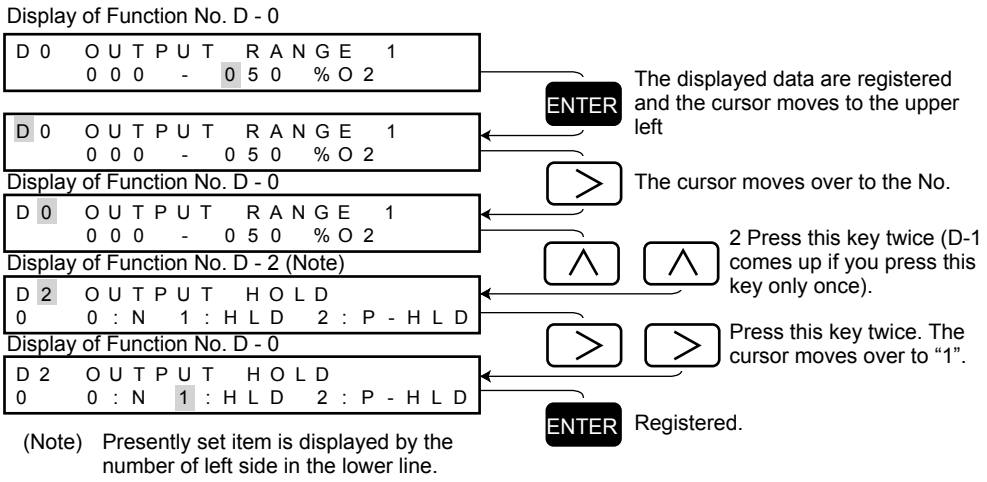
- **Selecting Function No. D-0 when already in Function No. C-1**


Display of Function No. C - 1
C 1 C A L G A S C O N C (% O 2)
Z E R O = 0 0 1 . 0 0
ENTER
The displayed data are registered and the cursor moves to the upper left.
C 1 C A L G A S C O N C (% O 2)
Z E R O = 0 0 1 . 0 0
Display of Function No. D - 1
The function group changes from Group C to D.
D 1 O U T P U T R A N G E 2
0 0 0 - 0 2 5 % O 2
The cursor moves over to the No.
D 1 O U T P U T R A N G E 2
0 0 0 - 0 2 5 % O 2
Display of Function No. D - 0
the no. decreases.
D 0 O U T P U T R A N G E 1
0 0 0 - 0 5 0 % O 2

(6) Entering the setting data (Selection of setting details)

Use the number increase key, number decrease key, cursor key, entry key, etc. Which keys you use depend on the present state you are in (i.e., the operation mode and the position of the cursor).

- **Selecting hold (HLD) in Function No. D-2 when already in Function No. D-0**

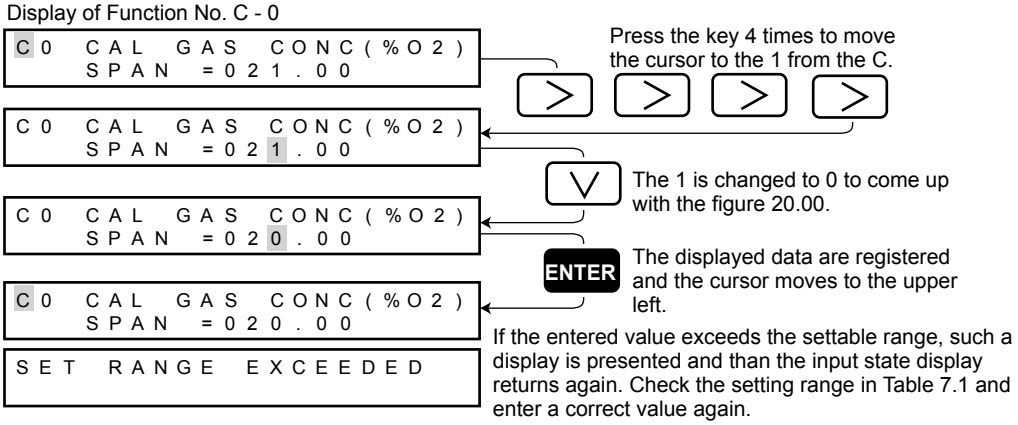

Display of Function No. D - 0
D 0 OUTPUT RANGE 1
0 0 0 - 0 5 0 %O2
ENTER
The displayed data are registered and the cursor moves to the upper left
D 0 OUTPUT RANGE 1
0 0 0 - 0 5 0 %O2
The cursor moves over to the No.
Display of Function No. D - 0
D 0 OUTPUT RANGE 1
0 0 0 - 0 5 0 %O2
2 Press this key twice (D-1 comes up if you press this key only once).
Display of Function No. D - 2 (Note)
D 2 OUTPUT HOLD
0 0 : N 1 : HLD 2 : P-HLD
Press this key twice. The cursor moves over to “1”.
Display of Function No. D - 0
D 2 OUTPUT HOLD
0 0 : N 1 : HLD 2 : P-HLD
ENTER
Registered.

(Note) Presently set item is displayed by the number of left side in the lower line.

(7) Entering the setting data (Input of data values)

Use the number increase key, number decrease key, cursor key, entry key, etc. Which keys you use depend on the present state you are in (i. e., the operation mode and the position of the cursor).

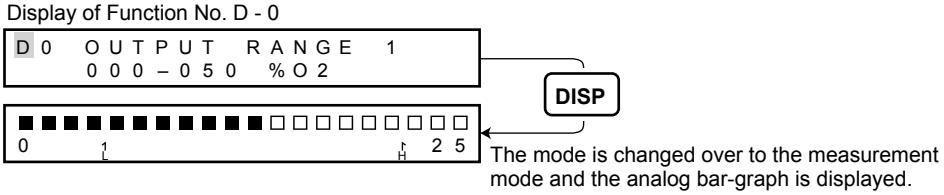
- **When span gas concentration is to be changed from 21.00 vol% O_2 to 20.00 vol% O_2 in Function No. C**


Display of Function No. C - 0
C 0 CAL GAS CONC(%O2)
SPAN =0 2 1 . 0 0
Press the key 4 times to move the cursor to the 1 from the C.
C 0 CAL GAS CONC(%O2)
SPAN =0 2 1 . 0 0
The 1 is changed to 0 to come up with the figure 20.00.
C 0 CAL GAS CONC(%O2)
SPAN =0 2 0 . 0 0
ENTER
The displayed data are registered and the cursor moves to the upper left.
C 0 CAL GAS CONC(%O2)
SPAN =0 2 0 . 0 0
SET RANGE EXCEEDED
If the entered value exceeds the settable range, such a display is presented and than the input state display returns again. Check the setting range in Table 7.1 and enter a correct value again.

(8) Changeover from the setting mode to the measurement mode

Use the measurement mode select key.

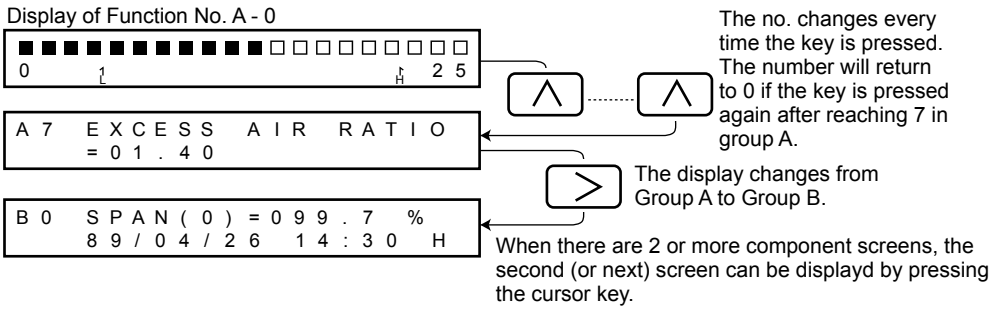
- **When changing over from Function No. D-0**


Display of Function No. D - 0
D 0 OUTPUT RANGE 1
0 0 0 – 0 5 0 %O2
DISP
0 L H 2 5
The mode is changed over to the measurement mode and the analog bar-graph is displayed.

(9) Changing displayed data

Use the number increase key to change the function number. Use the cursor key to change to another function group or to move to the next screen.

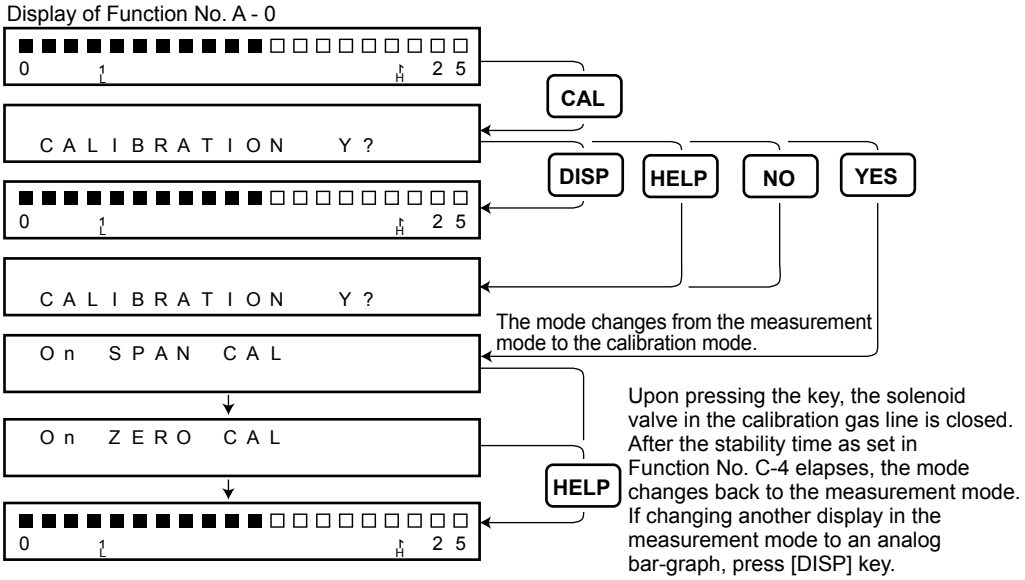
- **When changing from Function No. A-0**


Display of Function No. A - 0
0 L H 25
A 7 EXCESS AIR RATIO
= 0 1 . 4 0
B 0 SPAN (0) = 0 9 9 . 7 %
8 9 / 0 4 / 2 6 1 4 : 3 0 H
The no. changes every time the key is pressed. The number will return to 0 if the key is pressed again after reaching 7 in group A.
The display changes from Group A to Group B.
When there are 2 or more component screens, the second (or next) screen can be displayd by pressing the cursor key.

(10) Calibration start or suspension instructions

Use the calibration start or suspension key. For more details on the calibration keys, see Chapter 8.

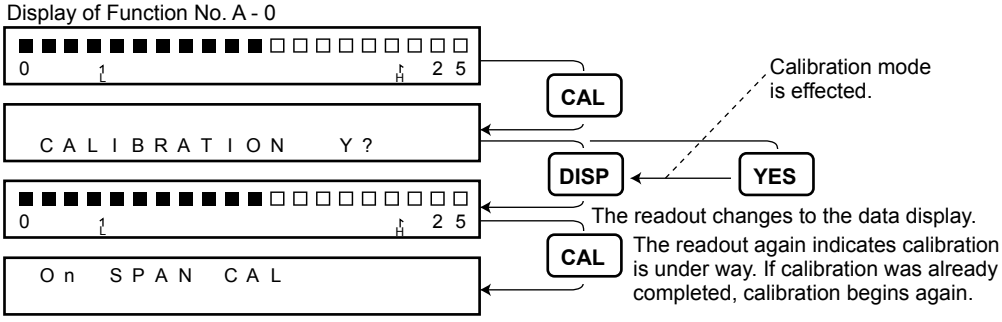
- **When a calibration start instruction issued in the semi-automatic calibration mode is suspended during mid-activity.**


Display of Function No. A - 0
0 L H 25
CAL
C A L I B R A T I O N Y ?
DISP
HELP
NO
YES
The mode changes from the measurement mode to the calibration mode.
O n S P A N C A L
O n Z E R O C A L
HELP
Upon pressing the key, the solenoid valve in the calibration gas line is closed. After the stability time as set in Function No. C-4 elapses, the mode changes back to the measurement mode. If changing another display in the measurement mode to an analog bar-graph, press [DISP] key.

(11) Displaying the data values in the calibration mode

You can display the readout from Function No. A-0. You can also display the set data in Function No. C-0 and subsequent functions. However, no data is settable.

- **When calibration commences in the semi-automatic calibration mode and the data is displayed**

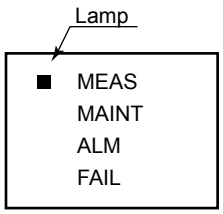

Display of Function No. A - 0
0 L H 25
CAL
Calibration mode is effected.
C A L I B R A T I O N Y ?
DISP
YES
The readout changes to the data display.
CAL
The readout again indicates calibration is under way. If calibration was already completed, calibration begins again.
O n S P A N C A L

7.2 Readout Displays

There are 3 kinds of readouts: a status display, data display, and message display on the operation panel of the converter. In the status readout, the operation mode and the error alarm (if any) are displayed. In the data readout, the measured oxygen concentration and the details of any error which has occurred are displayed. In the message readout, various measured data, set data and messages are displayed.

7.2.1 Status Display

The related operation mode and the occurrence of an alarm, etc. are indicated by lit-up lights.



Status display

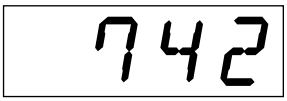
MEAS : Lights up in the measurement mode.
MAINT : Lights up in the calibration mode or setting mode. This light also glows when an error occurs with the instrument stopping measurement operations.
ALM : Lights up when an alarm is issued according to the details set in Function Nos. G - 0 to G - 2. The operation mode changes from the measurement mode to the maintenance mode depending on the type of alarm.
FAIL : Lights up when an error occurs while stopping the measurement operations of the instrument.

7.2.2 Data Display

This display incorporates a large 4-digit LED. Items displayed here are the warm-up state (warm-up symbol ON and the current temperature of the sensor), measured oxygen concentration (vol% O_2) and the error code. Normally, just the measured oxygen concentration is displayed.

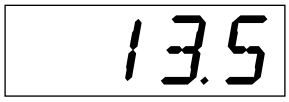
- **Example of warm-up state display**

Alternately displayed



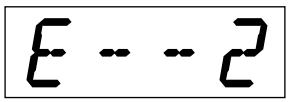
(Current temperature of sensor in °C)

- **Example of measured oxygen concentration display**



(Note 1) Measured value is displayed. Thus, aven if " 1 " (oxygen concentration in dry gas) is selected in function No. D-6, indication in the data display is the oxygen consentration in wet gas.

- **Example of error occurrence display**



(Note 2) An error display "E- -5", "E- -6" or "E- -7" generated in calibration is indicated olternately with oxygen consentration display.

7.2.3 Message Display

The message display incorporates the dot matrix LCD of 40 characters (20 characters x 2 lines). This readout displays the following messages:

To display the message of a value-setting group, you have to enter the specified password. The password is the 2-digit number "16".

(1) Measurement value group A (Function Nos. A-0 - A-7)

(2) Measurement value group B (Function Nos. B-0 - B-8)

(3) Value-setting group C (Function Nos. C-0 - C-7)

(4) Value-setting group D (Function Nos. D-0 - D-6)

(5) Value-setting group E (Function Nos. E-0 - E-2)

(6) Value-setting group F (Function Nos. F-0 - F-5)

(7) Value-setting group G (Function Nos. G-0 - G-4)

(8) Value-setting group H (Function Nos. H-0 - H-1)

(9) Value-setting group J (Function Nos. J-0 - J-7)

(10) Status message group

(11) Interactive message group

(12) Sub-message group

Among other message groups, the value-setting group has already been described in 6.1.6. For the status, interactive and sub-message groups to be displayed automatically, the relevant descriptions will be given when required (e.g., “Calibration” in Chapter 8).
Therefore, the following description describes only the messages in the measurement value groups (1) and (2):

<Displaying measurement value group messages>
A-0 Display of an Analog Bar-graph

When you press the measurement mode select key, an analog bar-graph is first displayed. On the top line is displayed the analog bar-graph showing the oxygen concentration of the measurement span. On the bottom line are displayed the minimum and maximum values of the measurement range and arrows indicating the lower limit alarm set value (Lo) and the upper limit alarm set value (Hi). When an error occurs, a message is also displayed. If there are multiple messages, “H” is displayed at the bottom right part of the display. Thus, in this case, display auxileary messages using [HELP] key to confirm the contents.

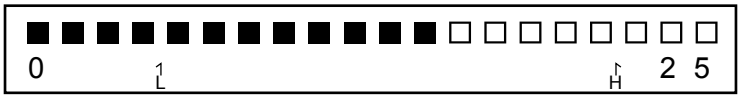
(1) The minimum unit on the analog bar-graph corresponds to 2.5% created by dividing the 100% of measurement span by 40. There is one displayed value after being smoothed.

(2) Displayable alarm set values (indexes) are those only for the lower and upper limits. The extreme upper and extreme lower limits, if any, are not displayed. In addition, if the lower or upper alarm set value is set in excess of the measurement range, it is not displayed either.

(3) If the alarm set value indication (index) overlaps the display unit of the minimum or maximum value in the measurement range, it is not displayed.

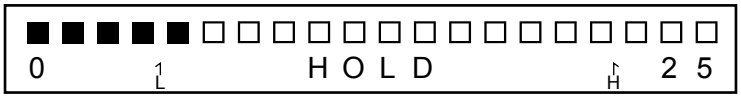
(4) If the analog bar-graph indicates the hold value (preset or preceding value), “HOLD” is displayed in the lower line.

Display of analog bargraph (Example 1)



(Note1) The value corresponding to the output current is shown in the analog bargraph. Therefore, when “1” is selected with function No. D-4, logarithmic indication of the current is displayed. Ehen “1” is selected with function No. D-6, oxygen concentration in dry gas is displayed.
(Note2) If a HOLD value is displayed, “HOLD” is also displayed.

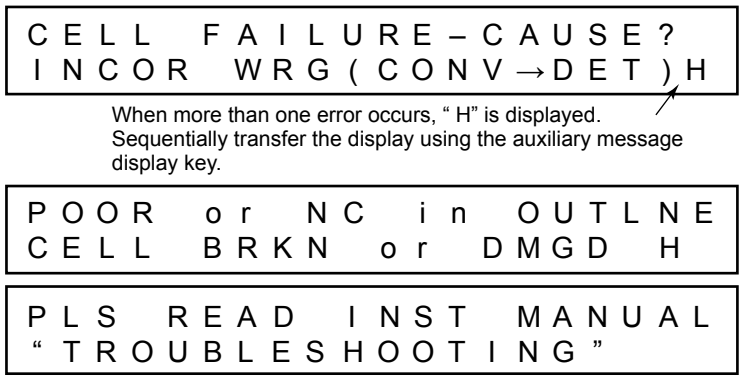
(Example 2):
In HOLD state



In addition, if an error occurs during displaying a bargraph, it changes to the following error message display.

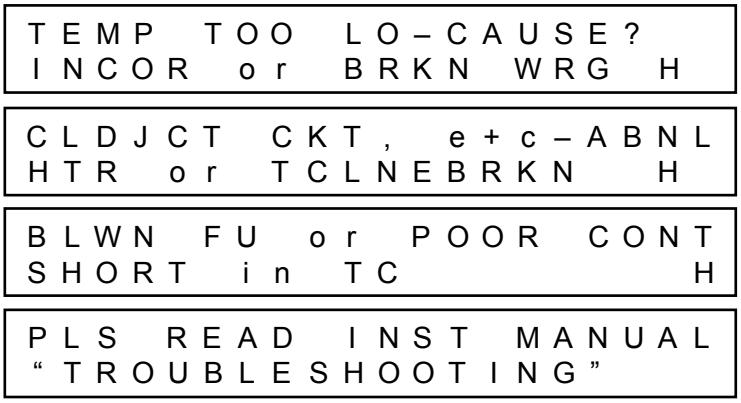
- **Error Code "E--1"**

Display when an error occurs (Example 1)


CELL FAILURE–CAUSE?
INCOR WRG(CONV→DET)H
When more than one error occurs, " H" is displayed. Sequentially transfer the display using the auxiliary message display key.
POOR or NC in OUTLNE
CELL BRKN or DMGD H
PLS READ INST MANUAL
" TROUBLESHOOTING"

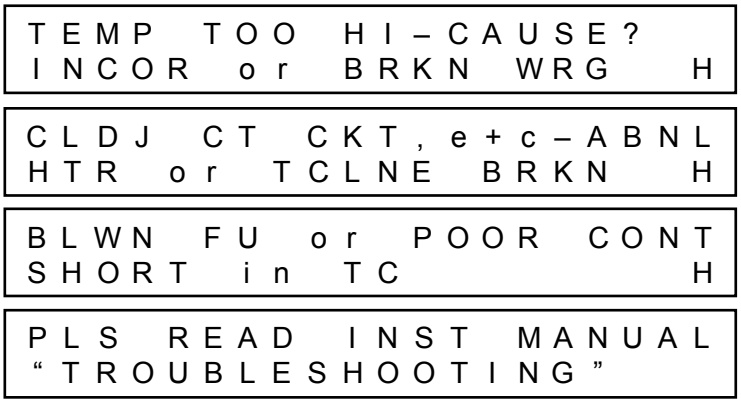
- **Error Code "E--2"**

Display when an error occurs (Example 2)



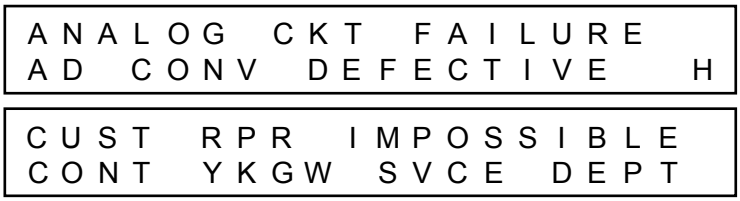
- **Error Code "E--3"**

Display when an error occurs (Example 3)


TEMP TOO HI–CAUSE?
INCOR or BRKN WRG H
CLDJ CT CKT, e+c–ABNL
HTR or TCLNE BRKN H
BLWN FU or POOR CONT
SHORT in TC H
PLS READ INST MANUAL
" TROUBLESHOOTING"

- **Error Code "E--4"**

Display when an error occurs (Example 4)



- **Error Code "E--5"**

Display when an error occurs (Example 5)

```
CALVALABNL (0 PT)
CAUSE? CELL DMGD H

CALGASFLRT <IND'D
POSSIBLE LEAK H

WRNG GAS-CHNG SPAN→0
DIFF CONC&MEM VAL H

PLS READ INST MANUAL
"TROUBLESHOOTING"
```

- **Error Code "E--6"**

Display when an error occurs (Example 6)

```
CALVAL ABNL-SPAN PT
CAUSE? CELL DMGD H

CALGAS FLRT <IND'D
POSSIBLE LEAK H

WRNG GAS-CHNG 0→SPAN
DIFF CONC&MEM VAL H

PLS READ INST MANUAL
"TROUBLESHOOTING"
```

- **Error Code "E--7"**

Display when an error occurs (Example 7)

```
STABTFNSHD- CAUSE?
TOV BFR OUT STBLN H

CAL GAS FLRT <IND'D
POS LKG/CELL DMGD H

PLS READ INST MANUAL
"TROUBLESHOOTING"
```

- **Error Code "E--8"**

Display when an error occurs (Example 6)

```
MEMORY FAILURE in
ROM/RAM H

CUST RPR IMPOSSIBLE
CONT YKGW SVCE DEPT
```

A-1 Maximum or Minimum O_2 Concentration

The maximum and minimum values of measured oxygen concentrations are stored and updated according to the time intervals set in Function No. F-2. In Function No. A-1, the latest values are displayed. By subsequently pressing "HELP", the auxiliary message display key, generated data and time of those values are displayed.

Display of maximum and minimum O_2 concentrations (example)

```
A1 MAX=19.32 %O2
   MIN=15.48 %O2 H
```

A-2 Mean O_2 Concentration

The mean value of the measured oxygen concentration is stored and updated according to the time intervals set in Function No. F-1. In Function No. A-2, the latest value is displayed.

Display of mean O_2 concentration (example)

```
A 2   A V E R A G E ( 0 2 4 h o u r )
      0 1 6 . 9 2   % O 2
```

A-3 Cell Voltage

Cell (sensor) voltage is an index for noting the deterioration of the sensor. In Function No. A-3, the cell voltage at the oxygen concentration presently measured is displayed. The sensor is judged to be normal if the measured value agrees with the theoretical value at the same oxygen concentration.

The following equation can obtain the theoretical value of cell voltage E when the sensor is controlled at 750°C:

$$E = -50.74 \log (Px/Pa) \text{ [mV]}$$

Where Px: O_2 concentration in the measurement gas

Pa: O_2 concentration in the comparison gas (21 vol% O_2)

Table 7.2 shows the relationship between the oxygen concentration and cell voltage.

Table 7.2 Oxygen Concentration, vol% O_2 Vs. Cell Voltage mV (Cell Temperature 750°C)

%O_2	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
mV	117.83	102.56	93.62	87.28	82.36	78.35	74.95	72.01	69.41

%O_2	1	2	3	4	5	6	7	8	9
mV	67.09	51.82	42.88	36.54	31.62	27.61	24.21	21.27	18.67

%O_2	10	21.0	30	40	50	60	70	80	90
mV	16.35	0	–7.56	–14.2	–19.2	–23.1	–26.5	–29.5	–32.1

%O_2	100
mV	–34.4

Display of cell voltage (example)

```
A 3   C E L L   E M F = 0 1 8 . 3 m V
```

A-4 Cell Temperature/Thermocouple Voltage

Cell temperature is measured using a type K (chromel-alumel) thermocouple. The cold junction of this thermocouple is located at the terminal end of the detector. The temperature at this cold junction is measured with a transistor. In Function No. A-4, displayed is a voltage affected by the temperature at the cold junction terminal.

If the cell temperature is higher than 780°C, error “E--3” is effected, while error “E--2” is displayed at 730°C or less.

(Note) When the cell temperature is to be determined based on the displayed voltage, compensate for voltage error due to the temperature at the cold junction.

Display of cell temperature / thermocouple voltage (example)

```
A 4   C E L L   T E M P = 0 7 5 0 ° C
      T C ( K )   E M F = 0 3 0 . 4 m V
```

A-5 Output Current/Output (Measurement) Range

The current output value (mA) of the output signal and the measurement range (vol% O_2) are displayed.

Display of the output current / measurement range (example)

```
A 5   O U T P U T = 1 0 . 4 m   A D C
      R A N G E = 0 0 0 – 0 2 5 % O 2
```

(Note) The relationship between the output values of the current (mA DC) and the oxygen concentration (vol% O_2) is as shown below:

(1) For a linear output signal of 0 to 20 mA DC:
Output current (mA) = 20 × (Px/RangeH)

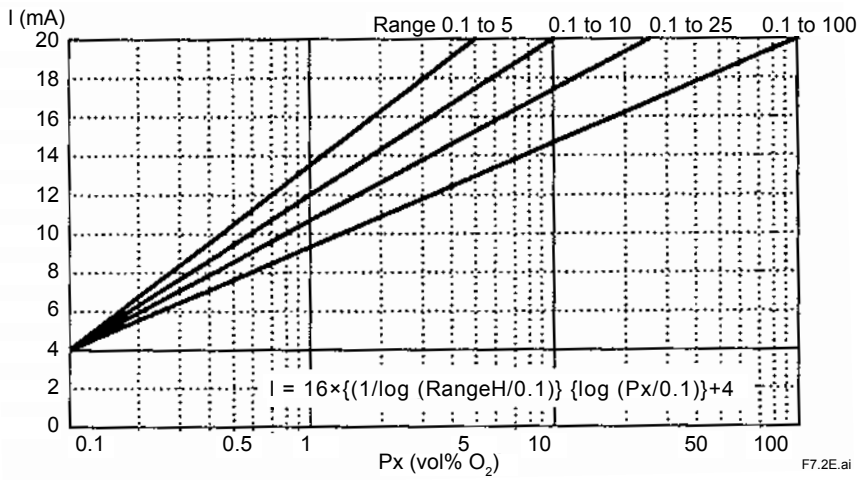
(2) For a linear output signal of 4 to 20 mA DC:
Output current (mA) = 16 × (Px/RangeH) + 4

(3) For a logarithmic output signal of 0 to 20 mA DC:
Output current (mA) = 20 × {(1/log (RangeH/0.1)} {log (Px/0.1)}

(4) For a logarithmic output signal of 4 to 20 mA DC:
Output current (mA) = 16 × {(1/log (RangeH/0.1)} {log (Px/0.1)} + 4

where Px: Oxygen concentration (vol% O_2)
RangeH: Maximum value of measurement range (vol% O_2)

The figure below indicates the relationship between each range and the logarithmic output signal (4 to 20 mA DC).



A-6 Time

The time is displayed by the clock function of the converter (year, month, day, hour, minute). If correction of this time is required, enter the correct time in Function No. F-0.

Display of time (example)

```
A 6   P R E S E N T   T I M E
      9 0 / 0 5 / 2 6   1 3 : 0 0
```

A-7 Air Ratio

The current air ratio, obrained by calculation, is displayed. If you use this air ratio data for estimating the combustion efficiency, etc., check that there is no air leaking in beforehand and that the measured value has not been affected by any interference gas (CH_4, CO, H_2, etc.).

Air ratio m is calculated by the following formula:

m ={1/(21 Oxygen concentration)} × 21

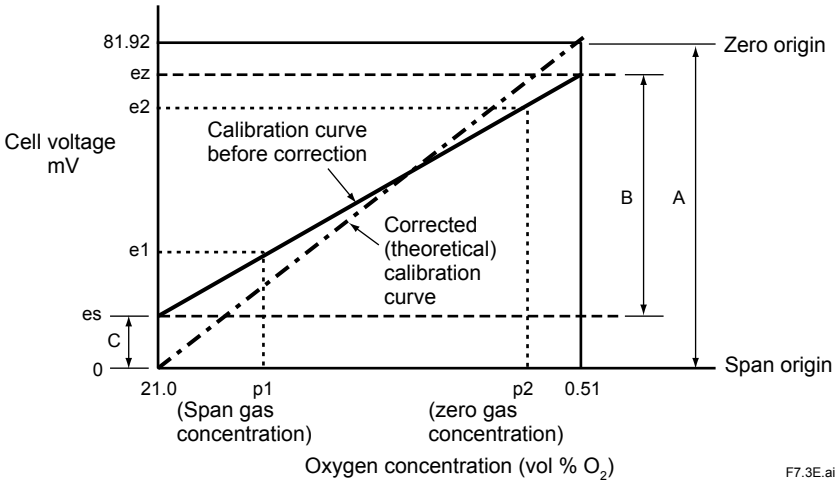
Display of air ratio (example)

```
A 7   E X C E S S   A I R   R A T I O
        0 3 . 5 9
```

A-7 is the last message in the measured value group A. If you want to display messages in measured value group B, press the cursor key.

B-0 Span Point Correction Ratio Record

The span point correction ratio, obtained every time the span point is calibrated, is displayed. You can determine the degree of deterioration in the cell (sensor) from this value. You can display the data record for the previous 10 times including the latest data. To display each datum on the screen, call up the next screen by pressing the message “HELP” key. You can have the span point correction ratio as follows. The correctable range of the span point is 0±18% (corresponding to a voltage at a span point of about ±15 mV).



Zero point correction factor = (B/A) × 100 (%) Correctable range : 100±30%
Span point correction factor = (C/A) × 100 (%) Correctable range : 0±18%

Figure 7.1 Calculation of the Zero Point Correction Ratio and the Span Point Correction Ratio

Display of the span point correction ratio record (1) (example)

```
B 0  S P A N  ( 0 ) = 0 0 1 . 5  %
     8 9 / 0 4 / 3 0    0 9 : 3 0  H
```

B-1 Zero Point Correction Ratio Record

The zero point correction ratio, obtained every time the zero point is calibrated, is displayed. You can determine the degree of cell (sensor) deterioration from this value. You can display the data record for the previous 10 times including the latest data. To display each data display screen, call up the next screen by pressing the message “HELP” key. You can get the zero point correction ratio by the method in Figure 7.1. The correctable range for the zero point is 100 ± 30%.

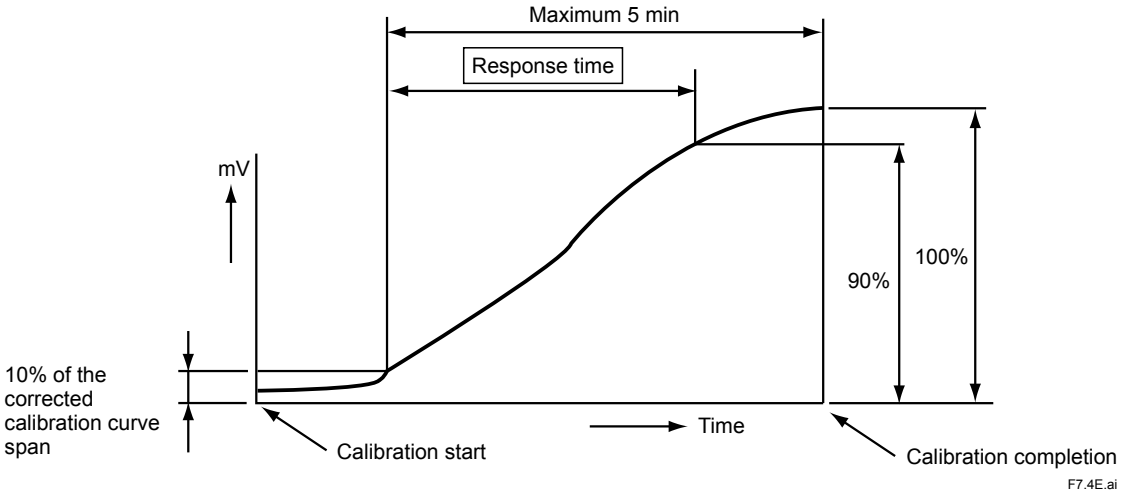
Display of the zero point correction ratio record (1) (example)

```
B 1  Z E R O  ( 0 ) = 0 9 8 . 7  %
     8 9 / 0 4 / 3 0    0 9 : 3 0  H
```

B-2 Response Time

Response time, displayed in Function No. B-2, can be obtained during calibration by the method in Figure 7.2.

(Note) If the zero point or the span point is skipped, it is not executed. In one-touch calibration mode, also not executed.



Response time is calculated after the corrected calibration curve is obtained. With a starting point where a voltage corresponding to 10% of the corrected calibration curve span is found, the time that it takes for the voltage to reach the 90 % mark of a 100 % voltage corresponding to the oxygen concentration of a calibration gas (zero gas) set in the converter is calculated. In other words, the response time for the above is in the range from 10 to 90 %.

Figure 7.2 Calculation of response time

Display of response time (example)

```
B 2   C E L L   R E S P O N S E
      ( 1 0 – 9 0 % )   = 0 0 3   s e c
```

B-3 Resistance in the Cell

A new cell (sensor) has an internal resistance of less than 200Ω. The resistance increases as the cell deteriorates. Therefore, the internal resistance of a cell is an index for indicating the degree of sensor deterioration. In Function No. B-3, the value obtained at the most recent calibration is displayed.

Display of inner resistance of cell (example)

```
B 3   C E L L   R E S I S T A N C E
          0 0 1 7 5   Ω
```

B-4 Robustness of the Cell

The robustness of the cell, an index for estimating the remaining life of the cell (sensor), is classified by a number from 5 (good) to 1 (poor). This robustness is determined after comprehensively evaluating various data monitored during calibration (e.g., the response time, the internal resistance of the cell, and the calibration coefficient). However, when the zero point or span is skipped, no response time is measurable. Thus, cell robustness is obtained from the other evaluation items.

Display of cell robustness (example)

```
B 4   S E L L   R O B U S T N E S S ( 5 )
      L I F E   >   1 2   M O N T H
```

B-5 Temperature at the Cold Junction on a Thermocouple

The temperature at the cold junction terminal, measured with a transistor, is displayed. The highest permissible temperature of the terminal depends on detectors: the temperature of the general detector is 80°C, and that of the high temperature detector is 150°C. If these temperatures are exceeded, they must be lowered by shielding the detector terminal box from radiation heat, etc.

Display of the temperature at the cold junction on a thermocouple (example)

```
B 5   C J   T E M P   = 0 0 2 6 ° C
```

B-6 Heater ON Time Ratio

The sensor in the detector is heated up to and maintained at a temperature of 750°C by the heater. The higher the temperature of the measurement gas is, the less the ON time of the heater becomes. However, if this time becomes too short, the temperature of the measurement gas might exceed the limit temperature of 600°C, which is not good for the detector. The heater ON time ratio is an index for monitoring an abnormal temperature rise in the measurement gas. However, its critical temperature rise varies depending on the conditions in individual processes. Therefore, no definite specifications are given herein. A general guideline, though, is about 20 to 30%.

Display of the heater ON time ratio (example)

```
B 6   C E L L   H E A T E R   D U T Y
          0 3 7 . 5   %
```

B-7 Dry O_2 Concentration / Moisture Content

When data corresponding to Function Nos. J-0 to J-7 are set, the captioned values are calculated based on the data while displaying the dry O_2 concentration (vol% O_2) and the moisture content (% H_2O) in the exhaust gas as follows:

Display of the dry O_2 concentration/ moisture content (example)

```
B 7   D R Y   O 2 = 0 9 7 . 5 1   % O 2
      S E T   H 2 O = 0 1 0 . 5   % H 2 O
```

The readouts of all the messages in measured value group B have been described on the preceding pages.

8. Calibration

In this Chapter, the method for calibrating a zirconia oxygen analyzer is described.

8.1 General

8.1.1 Principles of Zirconia Oxygen Analyzer

Before detailing calibration, the principles of measuring with a zirconia oxygen analyzer will be described.

A solid electrolyte such as zirconia allows the conductivity of oxygen ions in a high-temperature state. Therefore, when a zirconia-plated element with platinum electrodes on both sides is heated up in contact with gases having different partial-oxygen pressures on each side, the element shows the action of the concentration cell. In other words, the electrode in contact with a gas with a higher partial-oxygen pressure acts as a negative electrode. As the gas comes in contact with the zirconia element in this negative electrode, oxygen molecules in the gas acquire electrons and become ions. Moving in the zirconia element, they eventually arrive at the positive electrode on the opposite side. There, the electrons are released and the ions return to oxygen molecules. This reaction is indicated as follows:

Negative electrode : $O_2 + 4e \rightarrow 2O^{2-}$

Positive electrode : $2O^{2-} \rightarrow O_2 + 4\,e$

The electromotive force E (mV) between the 2 electrodes, generated by the reaction, is governed by Nernst's equation as follows:

$$E = -\frac{RT}{nF} \cdot \ln \frac{P_X}{P_A} \quad \cdots\cdots (1)$$

Where, R : Gas constant
T : Absolute temperature
n : 4
F : the Faraday constant
P_X : Oxygen concentration in the gas in contact with the negative zirconia electrode (%)
P_A : Oxygen concentration in the gas in contact with the positive zirconia electrode (%)

Assuming the zirconia element is heated up to 750°C, then the equation (1) becomes:

$$E = -50.74 \cdot \log \frac{P_X}{P_A} \quad \cdots\cdots (2)$$

With this analyzer, the sensor (zirconia element) is heated up to 750°C, so the relationship of equation (2) remains valid. At that time, a relationship, as in Figure 8.1, is effected between the oxygen concentration of the measurement gas in contact with the positive electrode and the electromotive force of the sensor (= cell), where a comparison gas of air is used on the negative electrode side.

Measurement principles of a zirconia oxygen analyzer have been described above. However, the relationship between oxygen concentration and the electromotive force of a cell is only a theoretical one. Usually, a practical sensor shows a slight deviation from the theoretical value. This is the reason why calibration is required. It's performed to obtain a calibration curve for correcting a deviation from a theoretical cell electromotive force.

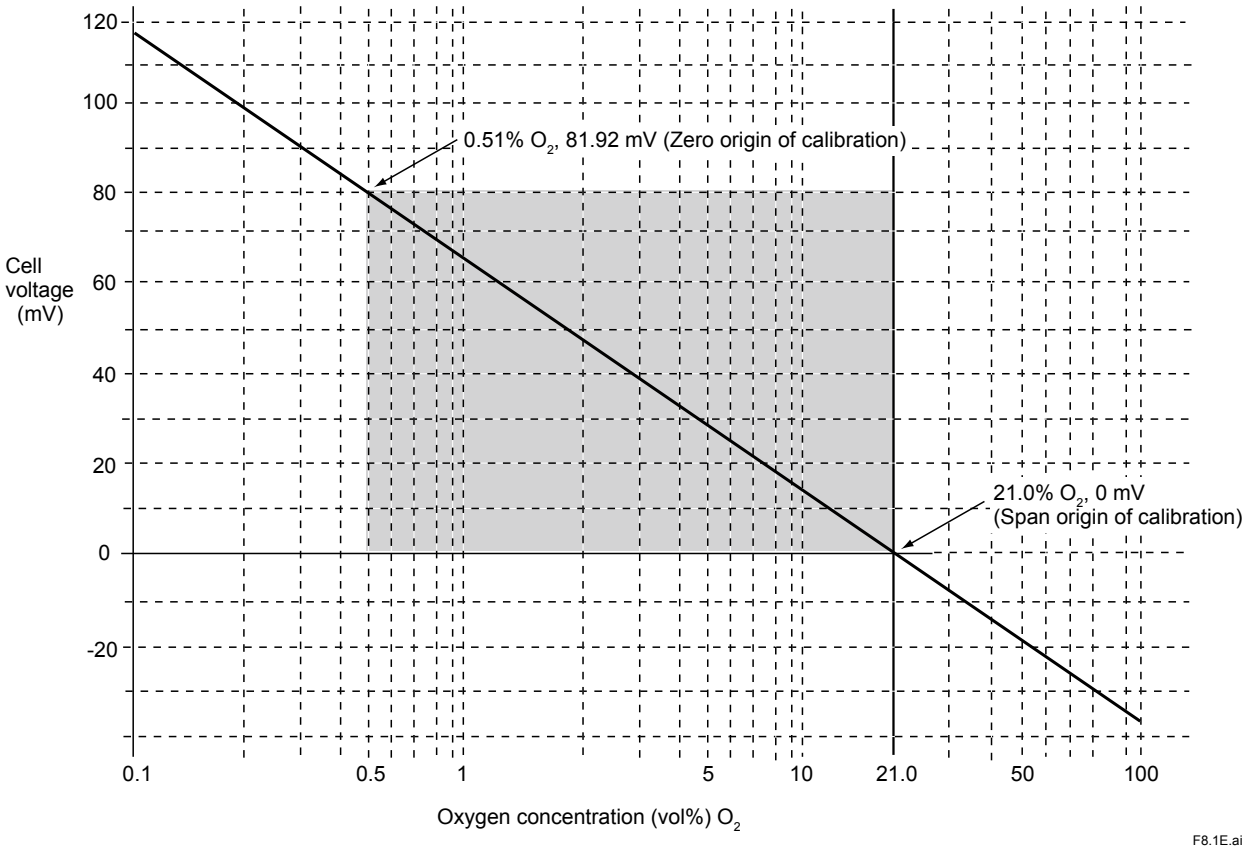


Figure 8.1 Oxygen Concentration in a Measurement Gas vs. Cell Voltage (21.0% O_2 Equivalent)

8.1.2 Calibration Gas

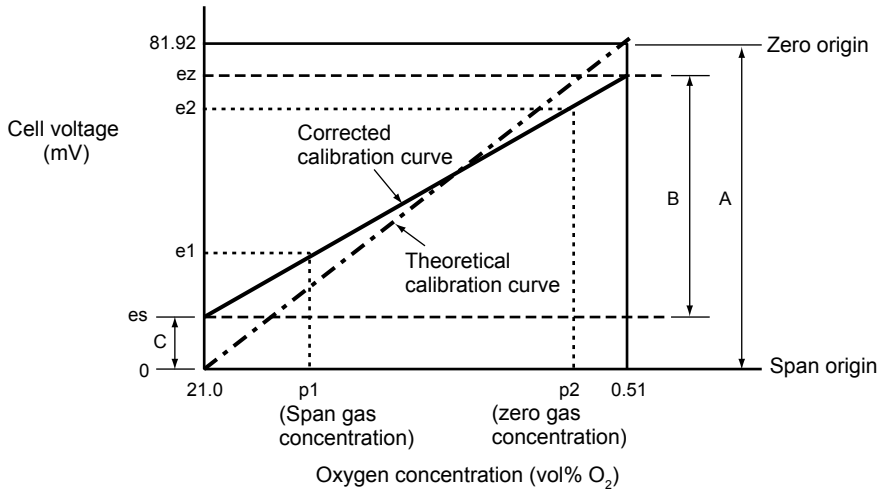
A gas with a known oxygen concentration is used for calibration. Normal calibration is performed using 2 different gases: a zero gas of low oxygen concentration and a span gas of high oxygen concentration. In some cases, only one or the other gas may be used for calibration,. However, even if only one of the gases is normally used, calibration using both gases should be done at least once.

The zero gas normally used has an oxygen concentration of 0.95 to 1.0 vol% O_2 with a balance of nitrogen gas (N_2). The span gas widely used is clean air (e.g., instrument air).

8.1.3 Compensation

The deviation of a measured value from the theoretical cell electromotive force is checked by the method in Figure 8.2 or 8.3.

Figure 8.2 shows a 2-point calibration using 2 gases : zero and span. Cell electromotive forces for a span gas with an oxygen concentration p1 and a zero gas with an oxygen concentration p2 are measured while determining a calibration curve passing between these 2 points. The oxygen concentration of the measurement gas is determined from this calibration curve. In addition, the calibration curve corrected by calibration is compared with the theoretical calibration curve for determining the zero point correction ratio represented by B/A × 100(%) on the basis of A, B and C shown in Figure 8.2 and the span point correction ratio of C/A × 100(%). If the zero point correction ratio exceeds a range of 100 ± 30% or the span point correction ratio becomes larger than 0 ± 18%, calibration of the sensor becomes impossible.

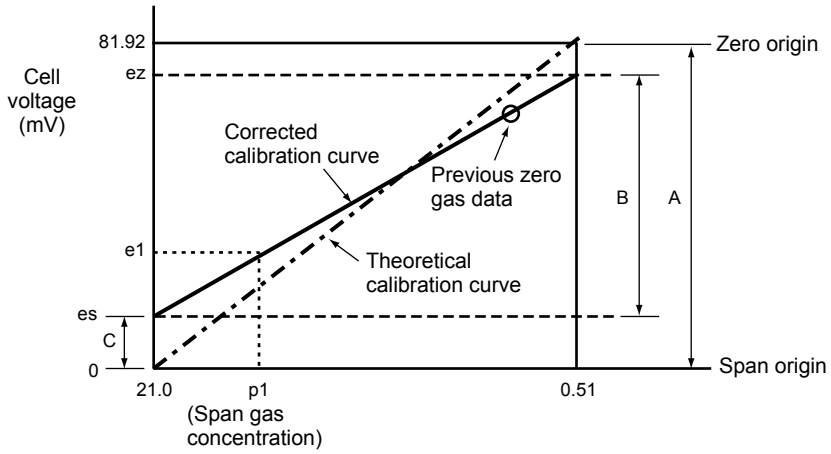


Zero point correction factor = (B/A) × 100 (%) Correctable range : 100 ± 30%
Span point correction factor = (C/A) × 100 (%) Correctable range : 0 ± 18%

F8.2E.ai

Figure 8.2 Calculation of a Calibration Curve and Correction Factor in a 2-Point Calibration Using Zero and Span Gases

Figure 8.3 shows a 1-point calibration using only a span gas. In this case, only the cell electromotive force for a span gas with an oxygen concentration p1 is measured. The cell electromotive force for the zero gas is carried over from a previous measurement to obtain the calibration curve. The principles of calibration using only a span gas also applies to the 1-point calibration method using a zero gas only.



Zero point correction factor = (B/A) × 100 (%) Correctable range : 100 ± 30%
Span point correction factor = (C/A) × 100 (%) Correctable range : 0 ± 18%

F8.3E.ai

Figure 8.3 Calculation of a Calibration Curve and Correction Factor in a 1-Point Calibration Using a Span Gas

8.1.4 Characteristic Data from a Sensor Measured During Calibration

During calibration, the following data for monitoring the conditions of the sensor are collected, as well as calibration data. However, if calibration is not properly executed (error occures in automatic or semi-automatic calibration), these data are not collected in the current calibration.

(1) Record of span correction factor
You can monitor values acquired from the past 10 calibrations using Function No. B-0.

(2) Record of zero correction factor
You can monitor values acquired from the past 10 calibrations using Function No. B-1.

(3) Response time
You can monitor the response time provided that a 2-point calibration has been performed. These values can be monitered using Function No. B-2.

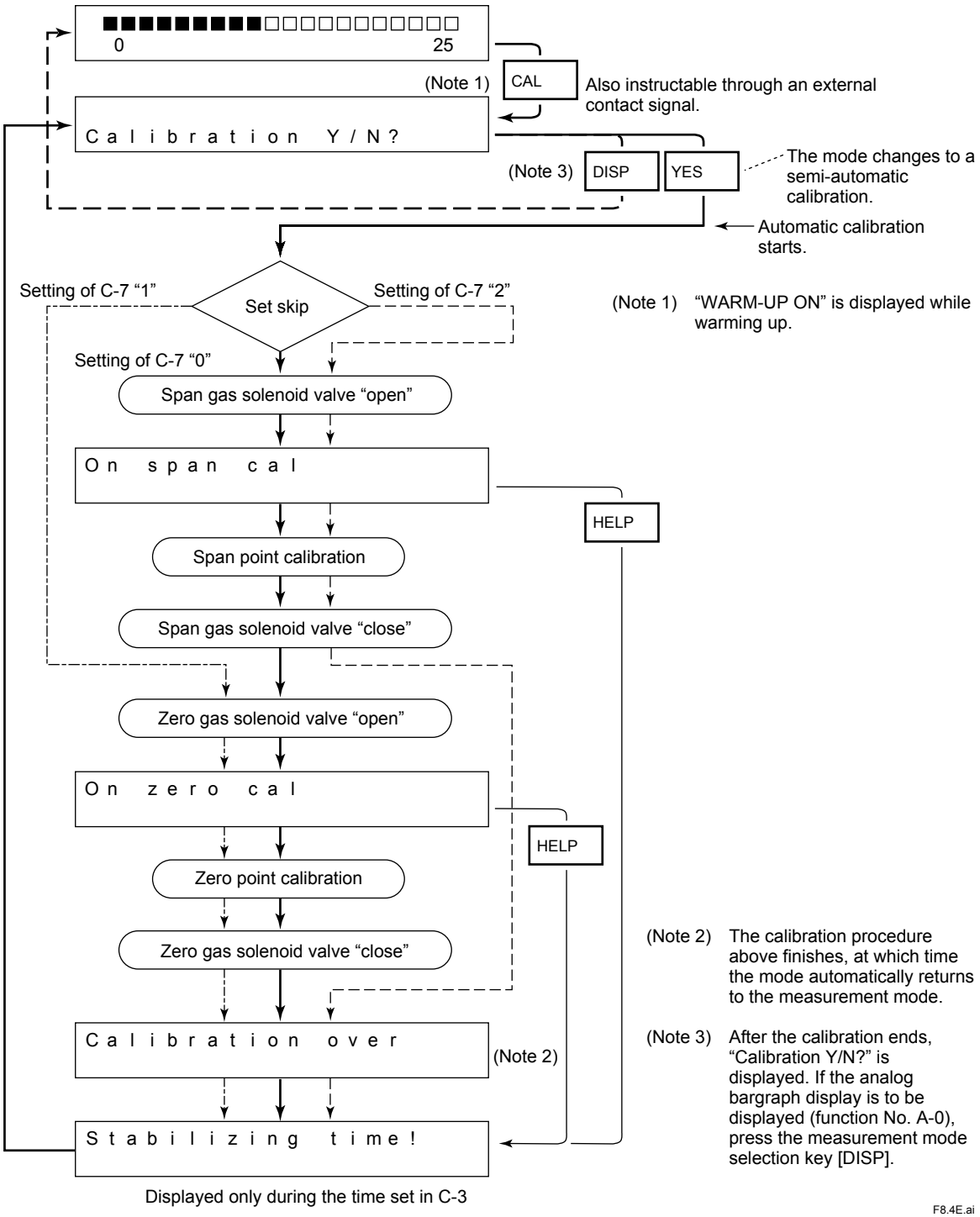
(4) Internal resistance of a cell
Internal resistance gradually increases as the cell (sensor) deteriorates. You can monitor the value measured during the latest calibration using Function No. B-3.

(5) Robustness of a cell
The robustness of a cell is an index for predicting the remaining life of a sensor and is expressed in a number on 5 levels. You can monitor cell robustness using Function No. B-4.

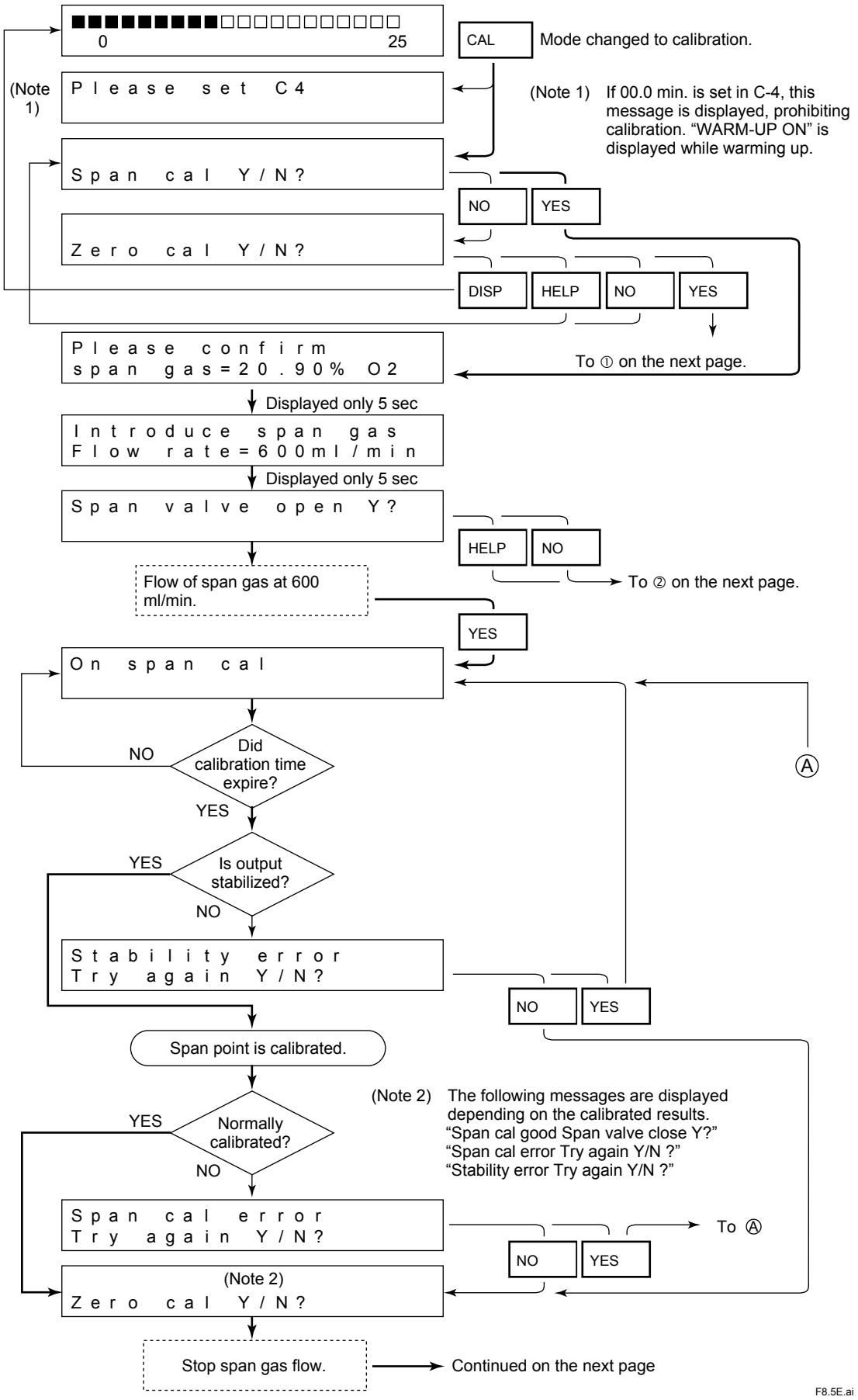
8.2 Calibration Procedures

In this Section, the procedures for operating semi-automatic, automatic and one-touch calibrations are described using flowcharts.

8.2.1 Operation Flowchart of Semi-Automatic and Automatic Calibrations


0
25
(Note 1)
CAL
Also instructable through an external contact signal.
Calibration Y/N?
(Note 3)
DISP
YES
The mode changes to a semi-automatic calibration.
Automatic calibration starts.
Setting of C-7 "1"
Set skip
Setting of C-7 "2"
Setting of C-7 "0"
Span gas solenoid valve "open"
On span cal
HELP
Span point calibration
Span gas solenoid valve "close"
Zero gas solenoid valve "open"
On zero cal
HELP
Zero point calibration
Zero gas solenoid valve "close"
Calibration over
(Note 2)
Stabilizing time!
Displayed only during the time set in C-3
(Note 1) "WARM-UP ON" is displayed while warming up.
(Note 2) The calibration procedure above finishes, at which time the mode automatically returns to the measurement mode.
(Note 3) After the calibration ends, "Calibration Y/N?" is displayed. If the analog bargraph display is to be displayed (function No. A-0), press the measurement mode selection key [DISP].
F8.4E.ai

8.2.2 Operation Flowchart


■■■■■■■■■□□□□□□□□□□□
0
25
CAL
Mode changed to calibration.
(Note 1)
P l e a s e s e t C 4
(Note 1) If 00.0 min. is set in C-4, this message is displayed, prohibiting calibration. “WARM-UP ON” is displayed while warming up.
S p a n c a l Y / N ?
NO
YES
Z e r o c a l Y / N ?
DISP
HELP
NO
YES
P l e a s e c o n f i r m
s p a n g a s = 2 0 . 9 0 % O 2
To ① on the next page.
Displayed only 5 sec
I n t r o d u c e s p a n g a s
F l o w r a t e = 6 0 0 m l / m i n
Displayed only 5 sec
S p a n v a l v e o p e n Y ?
HELP
NO
To ② on the next page.
Flow of span gas at 600 ml/min.
YES
O n s p a n c a l
NO
Did calibration time expire?
YES
YES
Is output stabilized?
NO
S t a b i l i t y e r r o r
T r y a g a i n Y / N ?
NO
YES
Ⓐ
Span point is calibrated.
(Note 2) The following messages are displayed depending on the calibrated results.
“Span cal good Span valve close Y?”
“Span cal error Try again Y/N ?”
“Stability error Try again Y/N ?”
YES
Normally calibrated?
NO
S p a n c a l e r r o r
T r y a g a i n Y / N ?
To Ⓐ
NO
YES
(Note 2)
Z e r o c a l Y / N ?
Stop span gas flow.
Continued on the next page

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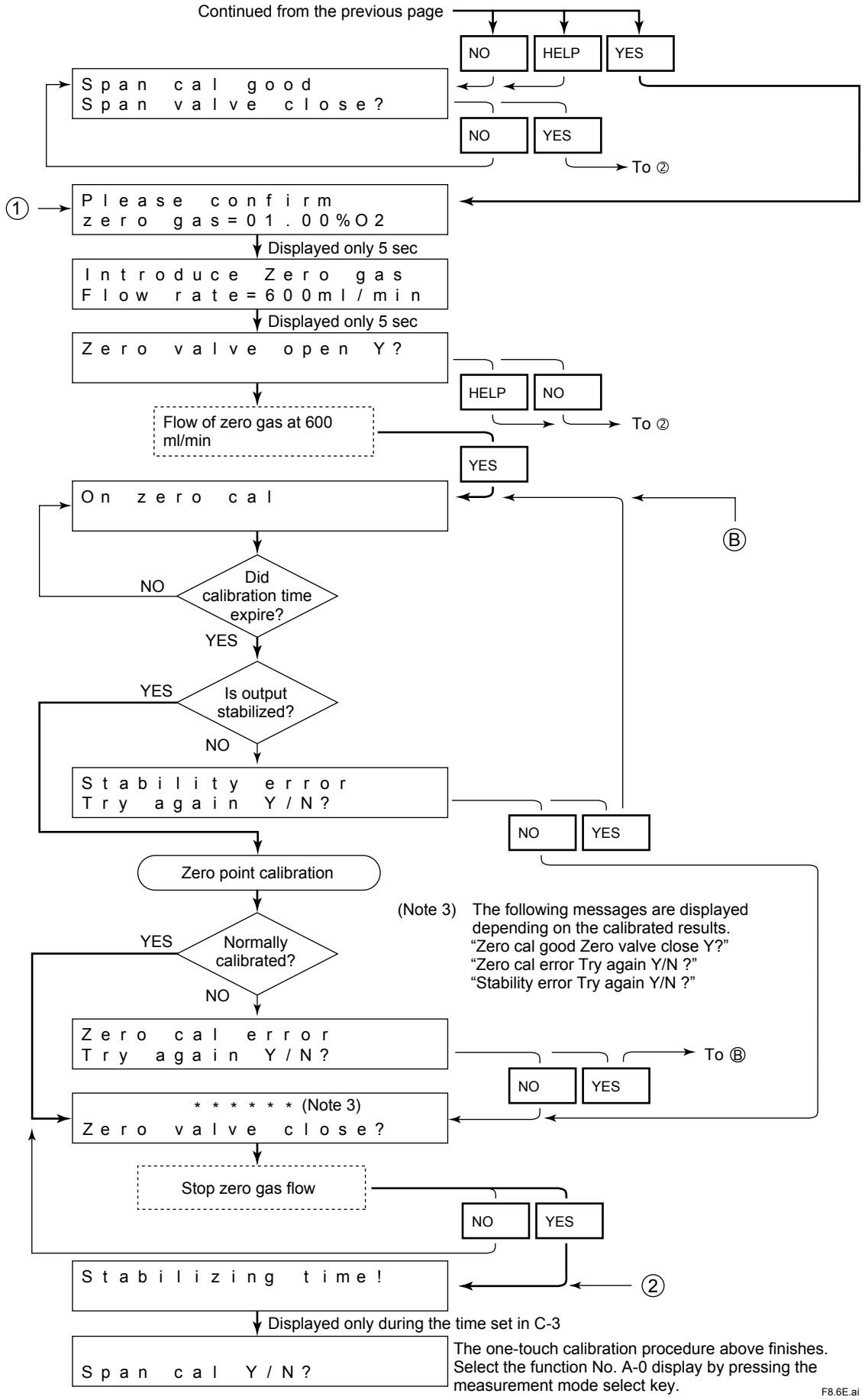
Continued from the previous page
NO
HELP
YES
Span cal good
Span valve close?
NO
YES
To ②
①
Please confirm
zero gas=01.00%O2
Displayed only 5 sec
Introduce Zero gas
Flow rate=600ml/min
Displayed only 5 sec
Zero valve open Y?
HELP
NO
To ②
Flow of zero gas at 600 ml/min
YES
On zero cal
Ⓑ
NO
Did calibration time expire?
YES
YES
Is output stabilized?
NO
Stability error
Try again Y/N?
NO
YES
Zero point calibration
(Note 3) The following messages are displayed depending on the calibrated results.
“Zero cal good Zero valve close Y?”
“Zero cal error Try again Y/N ?”
“Stability error Try again Y/N ?”
YES
Normally calibrated?
NO
Zero cal error
Try again Y/N?
To Ⓑ
NO
YES
****** (Note 3)
Zero valve close?
Stop zero gas flow
NO
YES
Stabilizing time!
②
Displayed only during the time set in C-3
Span cal Y/N?
The one-touch calibration procedure above finishes. Select the function No. A-0 display by pressing the measurement mode select key.
F8.6E.ai

8.3 Methods of Operating Valves in the ZA8F Flow Setting Unit

The ZA8F flow setting unit is used as a calibration device for a system conforming to Section 1.1.1 “Examples of System Configuration.” Calibration in such a system is to be operated as in a one-touch system. So, you have to operate the valve of the flow setting unit upon each calibration (starting and stopping the calibration gas flow and adjusting the flow rate).

8.3.1 Preparation before Calibration

To operate the ZA8F flow setting unit, prepare for calibration as follows:

(1) Check for a complete closing of the zero gas flow setting valve in the unit and open the regulator valve for the zero gas cylinder until the secondary pressure is 50 to 100 kPa.

(2) Check that the oxygen concentration of the zero gas in the cylinder is set in the converter.

8.3.2 Operating the Span Gas Flow Setting Valve

The following description is given assuming that instrument air, the same as the comparison gas, is used as the span gas.

(1) When the message “DID YOU OPEN SPAN VALVE Y?” is displayed in the readout of the converter during calibration, open the span gas flow setting valve of the flow setting unit and adjust the flow rate to 600 ± 60 ml/min. Turn the valve regulator slowly counterclockwise after loosening the lock nut. To check the flow rate, monitor the calibration as with a flow meter.

(2) After adjusting the flow rate, press the interactive key “YES” of the converter. Because of the time set in Function No. C-4, when this key is pressed, span point calibration is executed. When the message “SPAN CALIBRATION FINISHED” is displayed, close the span gas flow setting valve to stop the span gas (air) flow. Be sure to tighten the lock nut to prevent any leakage of span gas into the sensor during measurement because the valve may become loose during measurement.

8.3.3 Operating the Zero Gas Flow Setting Valve

Operation of the zero gas flow setting valve during zero point calibration is as follows:

(1) When the message “DID YOU OPEN ZERO VALVE Y?” is displayed in the readout of the converter during calibration, open the zero gas flow setting valve of the flow setting unit and adjust the flow rate to 600 ml/min. To rotate the valve shaft, loosen the lock nut and slowly turn it counterclockwise. To check the flow rate, monitor the calibration gas flow meter.

(2) After adjusting the flow rate, press the interactive key “YES” of the converter. Because of the time set in Function No. C-4, when this key is pressed, zero point calibration is executed. When the message “ZERO CALIBRATION FINISHED” is displayed, close the zero gas flow setting valve to stop the zero gas flow. Be sure to tighten the lock nut to prevent the any leakage of the zero gas into the sensor because the valve may become loose during measurement.

8.3.4 Treatment after Calibration

No special treatment of the instrument is needed after the completing the calibration. However, it is recommended that the regulator valve for the zero gas cylinder be closed if calibration will not be necessary so frequently in the future.

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9. Inspection and Maintenance

In this Chapter, inspection and maintenance for keeping or recovering the measuring performances of the EXA OXY Flameproof zirconia oxygen analyzer is described:

WARNING

- Before opening the cover of the ZS8C converter, remove power and make sure of non-hazardous (*) atmospheres.

  (*) The text plate says "Open circuit at non-hazardous location before removing cover," since the internal energy of the ZS8C converter decreases under the specified value.
  The definition of the non-hazardous area is followed by the description in the Users Guide to Installing Flameproof Electrical Apparatus at Plants, issued by the Technology Institution of Industrial safety, Japan: As a non-hazardous area is considered a place where no occurrence of explosive gas atmospheres is guaranteed by the foreperson and confirmed by a written document. Therefore, if non-hazardous area is secured, it is allowed to open the cover in the field.
- Before opening the cover of the ZS8D detector, remove power and allow the detector to stand at least 40 minutes.

9.1 Inspection and Maintenance of the Detector

9.1.1 Precautions for Inspecting the Detector

(1) Be careful not to touch any hot parts.
The sensor at the tip of the detector probe is heated up to 750°C during operation. If an operation is carried out immediately before inspection, be careful not to touch the probe with your finger tips.

(2) Do not drop or bump or cause any great impact on the sensor assembly.
The sensor is made of ceramic (zirconia). If the detector is dropped or hit with something, the sensor might be damaged and no longer work.

(3) Do not reuse a metal O-ring to seal the cell assembly. If you replace the cell or remove it from the probe for checking, be sure to replace the metal O-ring. Otherwise, the furnace gas may leak, and then the leaking corrosive gas will cause the built-in heater or thermocouple to go open circuit, or the detector may corrode.

(4) Before opening or closing the terminal box, first remove dust, sand, or the like from the terminal box cover.

9.1.2 Checking the Flow of Sucked Sample Gases

The flow of sample gases to be sucked through the filter at the tip of the probe is set to about 300 to 500 ml/min. However, the reduction of suction flow due to the clogging of the filter, capillary tube or ejector will cause deterioration of response or deviation of indication.

Check the suction flow according to the following procedure at the frequency of once a week at the beginning and determine the period based on the result of the data.

(1) Let the calibration gas (when comparing the oxygen concentration of a zero gas and span gas with that of sample gases, whichever with larger concentration deviation) of 1.5 l/min to 3 l/min flow through the calibration gas line. (When using the ZA8F flow setting gas unit, the flow rate exceeds the scale of the flowmeter. However, it does not affect the flowmeter.)

Note: When the ZA8F is used, the flame arrester at the tip of the detector inlet restricts the rate of flow to the cell to about 2.5 l/min. (supply pressure of 70kPa) even if the flowmeter needle valve is fully opened.

(2) Continue to allow the sample gas to flow for several minutes after the indication has stabilized at the oxygen concentration of the calibration gas.

(3) Take time until the indication begins to change since the flow of the calibration gas is stopped. If it is within one minute, the suction flow of the sample gases is will be correctly attained.

(4) Other checks

a. Pressure and flow rate of the flow setting unit
When using the flow setting unit, check the supply pressure to it.
Supply pressure: 67 kPa to 196 kPa
Check the reference air flow and calibration gas flow to be supplied to the detector.
(Especially, in automatic calibration)
Reference air flow: 300 ± 60 ml/min
Calibration gas flow: 600 ± 60 ml/min (check at calibration)

b. Primary and secondary pressures of a gas cylinder
Replace the gas cylinder when the primary pressure is 980 kPa or less.
Set the secondary pressure from 67 kPa or more to 196 kPa or less.

9.1.3 Calibration of Indication

The period of calibration of indication is different depending on measurement conditions. At the beginning of operation, carry out calibration at the frequency of once a week and determine the period based on those data.

9.1.4 Checking the Flow Setting Unit During Normal Operation

(1) Supply Pressure and Flowrate

When the flow setting unit is used, check to see that the supply pressure to the unit is normal.
Supply pressure : 67 kPa to 196 kPa
For an automatic calibration requirement, check that the reference air flow and the calibration gas flow supplied to the detector are normal.
Reference air flow : 300 ± 60 ml/min
Calibration gas flow : 600 ± 60 ml/min (checked during calibration)

(2) Calibration Gas Cylinder's Primary and Secondary Pressure

When the primary pressure falls below 980 kPa, replace the calibration gas cylinder. Set the calibration gas so that the secondary pressure will be between 67kPa and 196kPa.

(3) Checking the Filter Every Three Months

Check the filter at the tip of the probe every three months at the initial stages of operation. From this, decide an appropriate cycle for checking the filter. In a case where the suction flow of the sample gas decreases, check the filter for clogging. If a clogged filter is found, clean or replace it.

9.1.5 Cleaning the Sensor Assembly

CAUTION

If the sensor assembly is so detached, allow enough time for the detector to cool down from its high temperature.

If exhaust flue gas is sucked for a long period, dust in the flue sticks to the tube wall of suction path, which prevents gas flow and reduces suction flow. Especially, if temperature of the gas suction root is reduced than the sulfuric acid dew point of the flue gas because of some causes, condensation will occur and dust can easily adheres.

For reduction of suction flow, disassembling and cleaning of the sensor assembly are necessary. Carry them out according to the procedure described below.

(Note) ● As a rule, this work must be carried out in a state where both working place and inside of the furnace are safe against explosion. Especially, if the pressure in the flue is positive, care must be exercised.
● Do not reuse a gaskets (K9292UJ, K9292DL) to seal the detector.

(1) Removal of the detector

Loosen the four M8 Allen bolts fixing the detector and remove them. The flange J positioning is carried out by the two OD 8 mm spring pins.

(2) Removal of the flame arrester block F

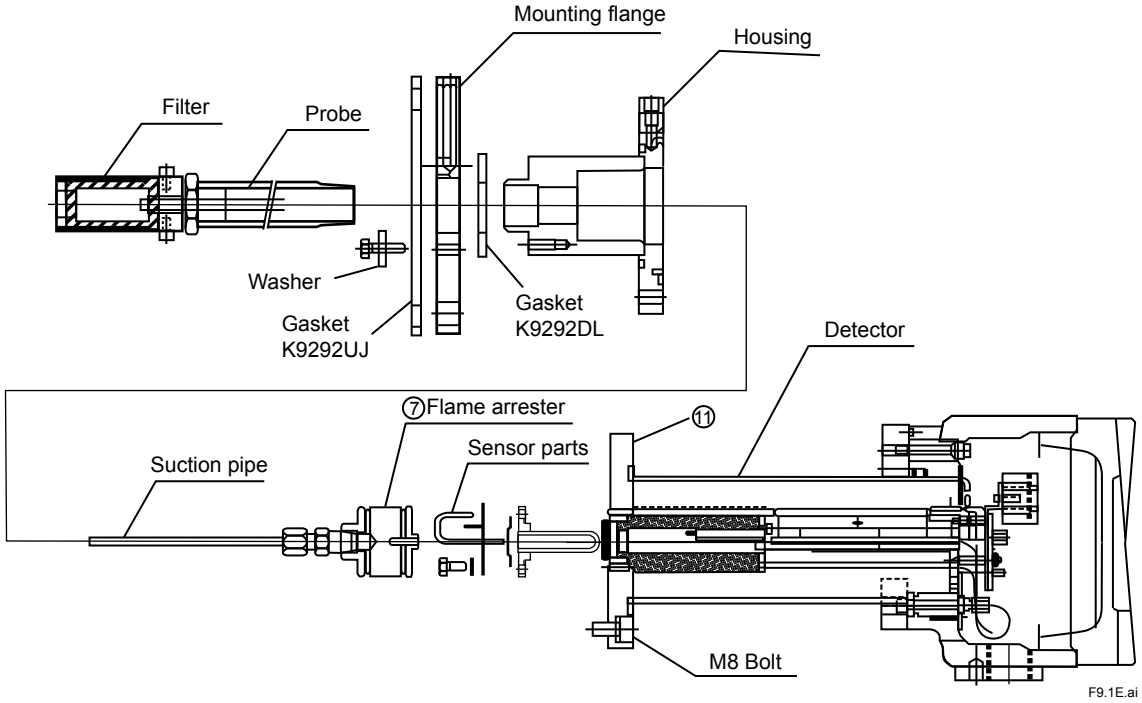
There is a M5 thread hole at the center of the flame arrester block F. Screw any M5 bolt into this hole and pull it out by pulling the bolt toward you. As the OD 6 mm/ID 4 mm stainless steel pipe is provided for the block, draw this pipe out also.

(3) Cleaning

If the surface of the sensor is dry and attachment can be easily removed, you can use an air gun to clean it off. If it cannot be removed, use boiling water or suitable solvent, etc. to clean it.

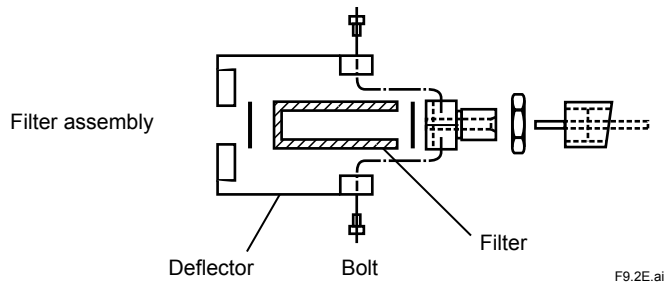
(4) Cleaning of other parts

Clean the mating surface of the flange, holes through which gas flows and the ejector by using an air gun or boiling water.



(5) Checking the probe

Check the filter at the tip of the probe at the frequency of once every three months at the beginning of operation, and determine the period based on the result of checking.
Also, when checking suction flow of sample gases, if reduction of suction flow is recognized, check the filter. If clogging is found, clean it or replace the entire filter assembly.



9.1.6 Cleaning the Calibration Gas Tube

The calibration gas, supplied through the calibration gas inlet of the terminal box into the detector, flows through the tube and comes out at the tip of the probe. The tube might become clogged with dust from the measurement gas. If you become aware of clogging, such as when a higher pressure is required to achieve a specified flow rate, clean the calibration gas tube.

To clean the tube, follow these steps:

(1) Remove the detector from the installation assembly.

(2) Following Section 9.1.7, later in this manual, remove the four bolts (and associated spring washers) that tighten the sensor assembly, and the pipe support as well as the U-shaped pipe.

(3) Use a rod 2 to 2.5 mm in diameter to clean the calibration gas tube inside the probe. In doing this, keep air flowing from the calibration gas inlet at about 600 ml/min and insert the rod into the tube (3-mm inside diameter). However, be careful not to insert the rod deeper than 40 cm for a general-purpose detector, or 15 cm for a high-temperature detector.

(4) Clean the U-shaped pipe. The pipe can be rinsed with water. However, it should be dried out thoroughly before reassembly.

(5) Restore all components you removed for cleaning. Follow Section 9.1.7 to restore all components in their original positions. Be sure to replace the O-ring(s) with new ones.

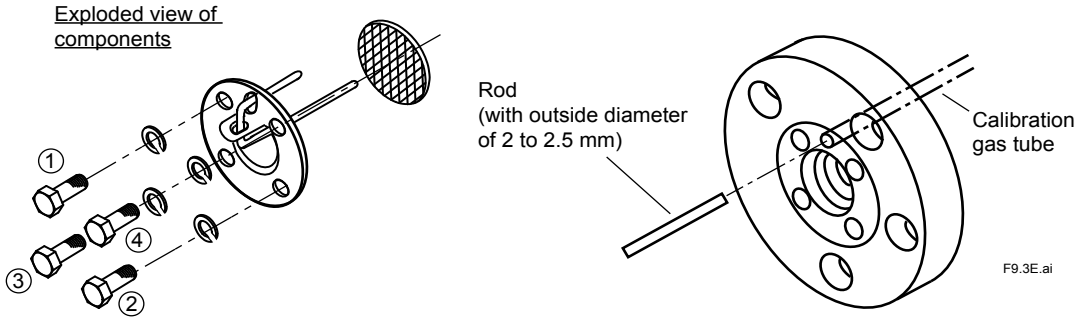


Figure 9.1 Cleaning of Calibration Gas Tube

9.1.7 Replacing the Sensor Assembly

The performance of the sensor (cell) deteriorates as its surface becomes soiled during operation. Therefore, you have to replace the sensor when its life expectancy expires, for example, when it can no longer satisfy a zero-gas ratio of 100 ± 30 % or a span-gas ratio of 0 ± 18 %. In addition, the sensor assembly is to be replaced if it becomes damaged and can no longer operate during measurement.

If the sensor becomes no longer operable (for example, due to breakage), investigate the cause and remedy the problem as much as possible to prevent recurrence.

CAUTION

- If the sensor assembly is to be replaced, allow enough time for the detector to cool down from its high temperature. Otherwise, you may get burned. If the cell assembly is to be replaced, be sure to replace the metal O-ring and the contact together. Additionally, even in a case where the cell is not replaced, if the contact becomes deformed and cannot make complete contact with the cell, replace the contact.
- If there is any corroded or discolored area in the metal O-ring groove in which the contact is embedded, sand the groove with sandpaper or use a metal brush, and then sand further with a higher grade of sandpaper (no. 1500 or so), or use an appropriate metal brush to eliminate any sharp protrusions on the groove. The contact's resistance should be minimized.

1. Identifying parts to be replaced

In order not to lose or damage disassembled parts, identify the parts to be replaced from among all the parts in the sensor assembly. Normally, replace the sensor, metal O-ring and contact together at the same time. If required, also replace the U-shaped pipe, bolts, filter and associated spring washers.

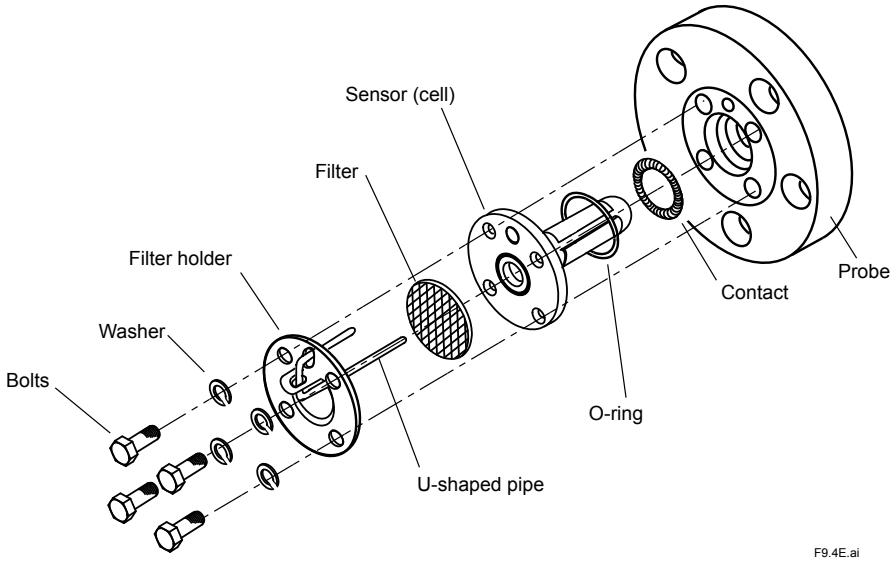


Figure 9.2 Exploded View of Sensor Assembly

2. Removal procedures

(1) Remove the four bolts and associated washers from the tip of the detector probe.

(2) Remove the U-shaped pipe support together with the U-shaped pipe. Remove filter also.

(3) Pull the sensor assembly toward you while turning it clockwise. Also, remove the metal O-ring between the assembly and the probe. Remove filter also.
(When replacing the assembly, be careful not to scratch or dent the tip of the probe with which the metal O-ring comes in contact (the surface with which the sensor flange also comes in contact). Otherwise, the measurement gas will not be sealed.)

(4) Use tweezers to pull the contact out of the groove in the tip of the probe.

(5) Clean the sensor assembly, especially the metal O-ring contact surface to remove any contaminants adhering to that part. If you can use any of the parts from among those removed, also clean them up to remove any contaminants adhering to them.
(Once the metal O-ring has been used, it can not be reused. So, be sure to replace it.)

3. Part assembly procedure

(1) First, install the contact. Being careful not to cause irregularities in the pitch of the coil spirals (i.e., not to bend the coil out of shape), place it in the ringed groove properly so that it forms a solid contact.

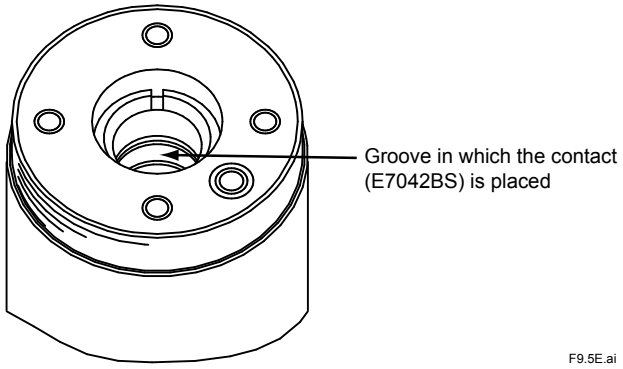


Figure 9.3 Installing the Contact

(2) Next, make sure that the O-ring groove on the flange surface of the sensor is clean. Install the metal O-ring in that O-ring groove, and then insert the sensor in the probe while turning it clockwise. After inserting it until the metal O-ring comes in contact with the probe's O-ring contact surface, properly align the U-shaped-pipe insertion holes with the bolt openings.

(3) Attach the U-shaped pipe to its support with filter, then fully insert the U-shaped pipe and its support into the probe.

(4) Coat the threads of the four bolts with antiseize grease and then screw them in along with the washers. First, tighten the four bolts uniformly by hand, and then use a torque wrench to tighten all areas of the metal O-ring uniformly, that is, to make sure the sensor flange is perfectly horizontal to the O-ring's working face in the probe. This is done by tightening first one bolt and then its opposing bolt each 1/8 turn, and then one of the other bolts followed by its opposing bolt, each also 1/8 turn. This continues in rotating fashion until they are all fully tightened with the torque wrench preset to approximately 5.9 N • m. If they are not uniformly tightened, the sensor or heater may be damaged.
Replacement of the sensor assembly is now complete. Install the detector and restart operation. Calibrate the instrument before making a measurement.

CAUTION

Optional Inconel bolts have a high coefficient of expansion. If excess torque is applied while the bolts are being tightened, abnormal strain or bolt breakage may result. So, tighten the bolts following the instructions given above.

9.1.8 Cleaning the High-Temperature Probe Adapter

CAUTION

- Do NOT subject the probe of the High-temperature Probe Adapter (ZS8P-H-B) to shock. This probe uses silicon carbide (SiC) which may become damaged if it is subjected to a strong shock or thermal shock.

The high-temperature detector is structured so that the gas to be measured is directed toward the detector with the high-temperature probe adapter. Therefore, if the probe or the sample gas outlet clogs, a precise measurement is no longer possible because of no gas flow. If you use the high-temperature detector, you have to inspect it periodically and, if any part of it is significantly clogged with dust, clean it.

Dust found sticking to the probe should be blown off. If any dust still remains after the blowing, clean it with a metal rod, etc., inserted. In addition, if dust is found on the auxiliary ejector or needle valve (choke) at the sample gas outlet, remove these parts from the high-temperature probe adapter and then clean them. To remove dust, blow air on them or rinse them with water.

9.2 Inspection and Maintenance of the Converter

You need not inspect or perform maintenance work on the converter daily or periodically. If the converter fails to work properly, it might come from power failure or other causes in most cases. However, burned out fuses or ambiguous readouts on the message display after long-time use are sometimes caused by deterioration of the related parts.

9.2.1 Replacing Fuses

The converter incorporates a total of 6 fuses: 2 for the detector heater and 2 for the electric circuit in the converter except 2 main fuses for whole protection. If any fuse burns out, replace it in the following manner. However, it is recommended that the fuses for the detector heater (F1, F2) be replaced every 2 years even if they are not burned out.

(Note) If a replaced fuse blows out immediately, a problem may exist in the circuit. Completely go over the circuit to find out why the fuse blew.

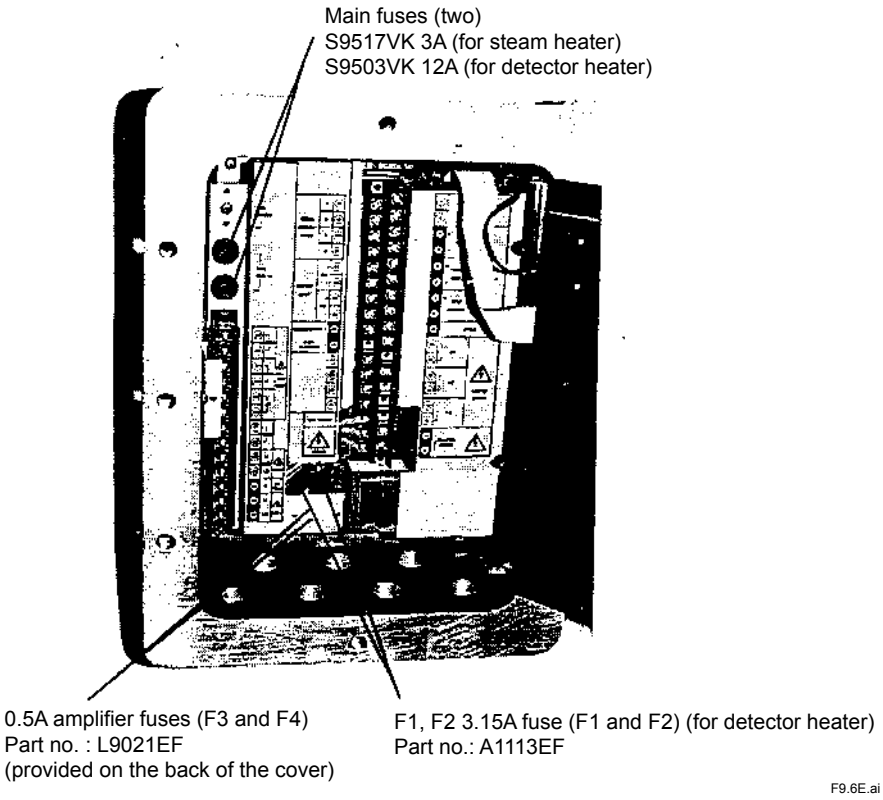

Main fuses (two)
S9517VK 3A (for steam heater)
S9503VK 12A (for detector heater)
0.5A amplifier fuses (F3 and F4)
Part no. : L9021EF
(provided on the back of the cover)
F1, F2 3.15A fuse (F1 and F2) (for detector heater)
Part no.: A1113EF
F9.6E.ai

Figure 9.3 Locations of Fuses for Converter

<Main fuse>

(1) Before replacing the fuse, turn off the converter's power supply.

(2) Loosen the fuse from its holder by turning the holder cap counterclockwise. Then remove the fuse with its cap from the holder.

(3) Be sure that the new fuse is rated at 3.15A. Insert it into the fuse cap and then place it in the fuse holder. To complete the replacement, turn the cap clockwise until it stops.

<Replacement of Detector Heater Fuses (F1, F2) >

Replace the fuses for the detector heater in the following manner:

(1) Turn OFF the power to the converter for safe replacement work.

(2) Remove the fuses from the fuse holders. Turn the fuse holder cap 90 counterclockwise using a flat blade screwdriver that just fits the holder cap slot. In this state, the fuse can be pulled out together with the cap.

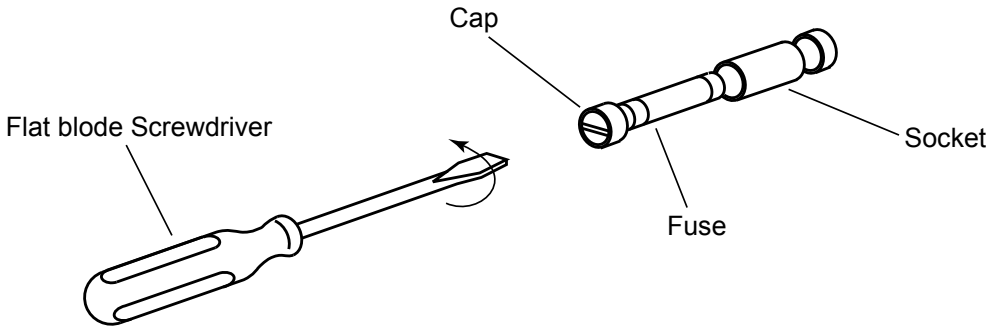


Figure 9.4 Removal of Fuse F1 and F2 (When converter for 100 V series power).

(3) After checking that the new fuse has the specified rating (3.15 A), place this new fuse (cartridge glass-tube fuse) in the holder. Insert the fuse into the cap and then both into the holder. Turn the cap 90 clockwise while pushing it at the same time with a flat blade screwdriver.

< Replacing the fuses (F3, F4) to protect the electric circuit in a converter >

(1) Turn OFF the main switch of the converter to maintain safety while replacing the fuse.

(2) Remove the fuse. Fuses F3, F4 are cartridge socket types in which 2 prongs of the fuse are inserted into the socket on the printed circuit board. If you cannot remove fuses F3, F4 easily with your hand, use a tool such as long nose or needle nose pliers.

(3) Check the new fuse for the specified rating (0.5 A) before installing it. Hold the body of the fuse gently with a pair of pliers and fully insert the 2 prongs into the socket on the printed circuit board. Be careful not to bend the prongs during installation (otherwise, the fuse may be damaged).

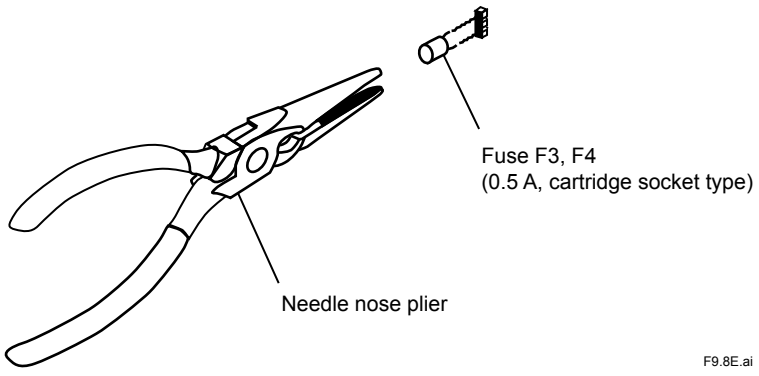


Figure 9.5 Removal of Fuse F3 and F4.

9.2.2 Replacing the Message Display Unit

The dot matrix LCD, incorporated in the message display unit, has a high performance and durability for long-time operation. However, after long-time use, the performance deteriorates gradually and unavoidably (i.e., giving ambiguous readouts, etc.) If the readout on the display becomes indistinct, replace the matrix LCD. To replace the LCD, remove it together with the entire unit.

If an error in your message display unit cannot be adjudged as to whether it is due to failure in the dot matrix LCD or a different cause, contact YOKOGAWA.

10. Troubleshooting

This chapter describes the checking and restoring methods when the ZS8C converter self-diagnosis function detected errors or other troubles occur.

WARNING

- Before opening the cover of the ZS8C converter, remove power and make sure of non-hazardous (*) atmospheres.

  (*) The text plate says "Open circuit at non-hazardous location before removing cover," since the internal energy of the ZS8C converter decreases under the specified value.
  The definition of the non-hazardous area is followed by the description in the Users Guide to Installing Flameproof Electrical Apparatus at Plants, issued by the Technology Institution of Industrial safety, Japan: As a non-hazardous area is considered a place where no occurrence of explosive gas atmospheres is guaranteed by the foreperson and confirmed by a written document. Therefore, if non-hazardous area is secured, it is allowed to open the cover in the field.
- Before opening the cover of the ZS8D detector, remove power and allow the detector to stand at least 40 minutes.

CAUTION

a. The probe adaptor and detector tip are extremely hot. Do not touch these portions. Otherwise, you may get burned.

b. When the sensor is to be replaced, first allow it to cool sufficiently. If you attempt to replace the sensor while it is still hot, the sensor may be damaged because its mechanical strength is weak while it is at hot state.

c. As a flame arrester, the detector flange surface is very important for explosion protection. Do not scratch the flange surface nor tighten the flanges with foreign matter between them. Also handle the converter flange surface with care for explosion protection.

10.1 Disposal When an Error Code Is Displayed

10.1.1 Types of Error Codes

There are nine types of error that can be detected with the self-diagnosis function of ZS8C converter. When these errors occur (except for digital circuit failures), the corresponding error codes are displayed in the data display. In the message display, error messages are also displayed. In addition, if more than one error occurs simultaneously, the letter “H” is also displayed in the message display. In this case, by selecting the displayed message using the auxiliary message display key “HELP”, individual error that occurred can be confirmed.

Error codes and their contents are shown in Table 10.1.

Table 10.1 Error Codes, Their Contents and States When Each Error Occurs

Error code	Error contents	State when the error occur
E– –1	Sensor failure (cell)	The analyzer goes to the fail mode and power to the detector heater is automatically turned off.
E– –2	Sensor temperature error “Low”	The analyzer goes to the fail mode and power to the detector heater is automatically turned off.
E– –3	Sensor temperature error “High”	The analyzer goes to the fail mode and power to the detector heater is automatically turned off.
E– –4	A / D (analog circuit) failure	The analyzer goes to the fail mode and power to the detector heater is automatically turned off.
E– –5	Calibration value error “Zero”	(Displayed in calibration) The current zero point calibrated value is not employed.
E– –6	Calibration value error “Span”	(Displayed in calibration) The current span calibrated value is not employed.
E– –7	EMF stabilization time-over	(Displayed in calibration) The current calibrated value is not employed.
E– –8	ROM or RAM failure	The analyzer goes to the fail mode and power to the detector heater is automatically turned off.
□□□□ (Display disappears)	Digital circuit failure Power interruption occurs	The analyzer goes to the fail mode and power to the detector heater is automatically turned off. (Displayed in turning power on again after power off) Data value default.

Errors displayed with error code “E--5”, “E--6”, or “E--7” are those generated in carrying out automatic or semi-automatic calibration. If these errors occur, that error code and oxygen concentration value are alternately displayed in the data display. The error is released when the analyzer returns to the measurement mode and, at the same time, the error code display disappears. The error message display is cleared by pressing the measurement mode select key “DISP”

(Note) Re-calibration after an error occurred should be performed after examining that setpoints and piping conditions are not improper.

Errors displayed with error code “E--l”, “E--2”, “E--3”, “E--4” or “E--8” including digital circuit failure occur generally caused by equipment failures: If these errors occur, the converter stops the supply of power to the detector heater and holds the output signal at the value immediately before the error occurrence (preset value if “2” is set with function No. D-2). When these errors occur, turn off the converter power and practice restoration. The error code display is released after the equipment is restored and operates normally.

10.1.2 Causes of “E--1 Sensor (Cell) Failure” and Procedure for Restoration

< Causes >

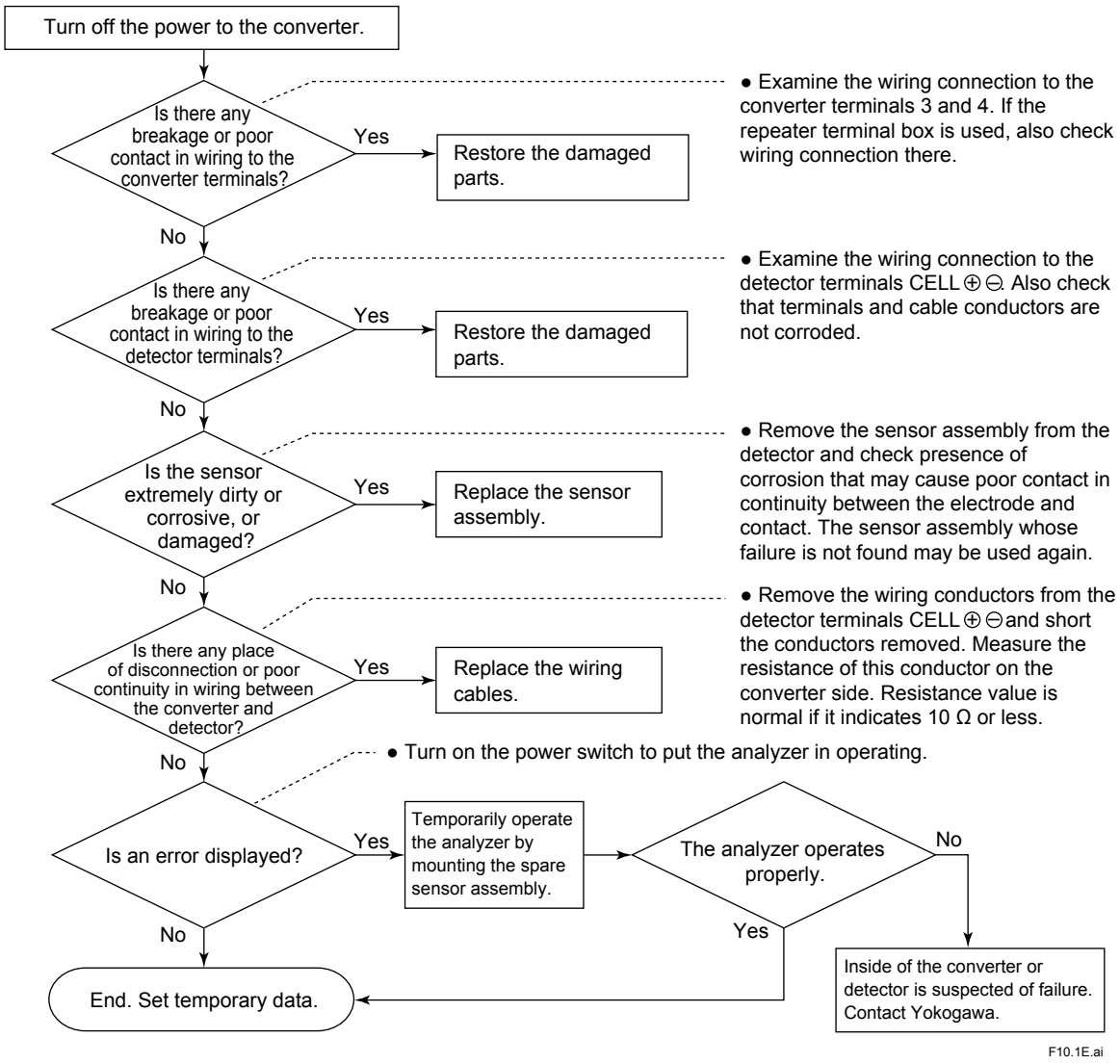
(1) Failure in wiring between the converter and the detector (poor contact of terminal connections, disconnection, etc.)

(2) Sensor (cell) assembly failure (damage, deterioration)

(3) Failure in the sensor (cell) assembly mounting part (poor continuity between the sensor electrode and the contact, etc.)

(4) Wiring system failure inside the detector (disconnection, etc.)

< Locating the Failure and Taking Measures >


Turn off the power to the converter.
Is there any breakage or poor contact in wiring to the converter terminals?
Yes
Restore the damaged parts.
No
● Examine the wiring connection to the converter terminals 3 and 4. If the repeater terminal box is used, also check wiring connection there.
Is there any breakage or poor contact in wiring to the detector terminals?
Yes
Restore the damaged parts.
No
● Examine the wiring connection to the detector terminals CELL ⊕ ⊖. Also check that terminals and cable conductors are not corroded.
Is the sensor extremely dirty or corrosive, or damaged?
Yes
Replace the sensor assembly.
No
● Remove the sensor assembly from the detector and check presence of corrosion that may cause poor contact in continuity between the electrode and contact. The sensor assembly whose failure is not found may be used again.
Is there any place of disconnection or poor continuity in wiring between the converter and detector?
Yes
Replace the wiring cables.
No
● Remove the wiring conductors from the detector terminals CELL ⊕ ⊖ and short the conductors removed. Measure the resistance of this conductor on the converter side. Resistance value is normal if it indicates 10 Ω or less.
● Turn on the power switch to put the analyzer in operating.
Is an error displayed?
Yes
Temporarily operate the analyzer by mounting the spare sensor assembly.
The analyzer operates properly.
No
Inside of the converter or detector is suspected of failure. Contact Yokogawa.
Yes
No
End. Set temporary data.

F10.1E.ai

10.1.3 Causes of "E--2 Sensor Temperature Error (Low)" and Procedure for Restoration

This error occurs when the sensor temperature after warm-up (in steady state operation) is lower than 720°C.

< Causes >

(1) Fuse (F1 and/or F2) for the detector heater in the converter is blown.

(2) Failure in wiring between the converter and the detector (poor contact of terminal connections, disconnection, shortcircuiting, etc.)

(3) Failure of Sensor for cold junction compensation at the detector terminal board (poor contact in terminal connections, or failure)

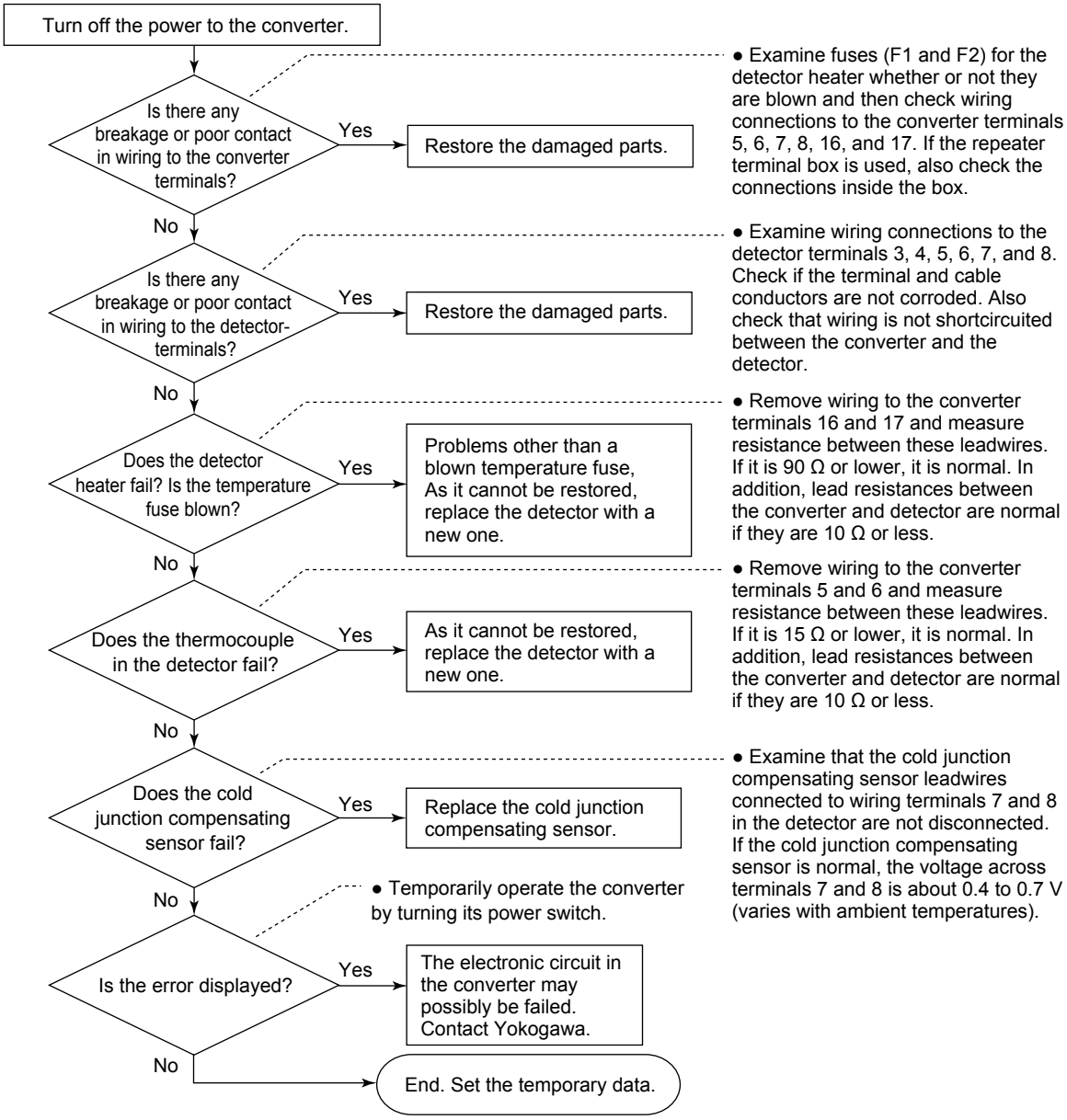
(4) Failure of thermocouple in the detector (disconnection, shortcircuiting in wiring inside the detector)

(5) Failure of the heater inside the detector (disconnection, etc.)

(6) Blown heater temperature fuse in the detector

(7) Electronic circuit failure inside the converter

< Locating the Failure and Taking Measures >


Turn off the power to the converter.
Is there any breakage or poor contact in wiring to the converter terminals?
Yes
Restore the damaged parts.
No
Is there any breakage or poor contact in wiring to the detector-terminals?
Yes
Restore the damaged parts.
No
Does the detector heater fail? Is the temperature fuse blown?
Yes
Problems other than a blown temperature fuse, As it cannot be restored, replace the detector with a new one.
No
Does the thermocouple in the detector fail?
Yes
As it cannot be restored, replace the detector with a new one.
No
Does the cold junction compensating sensor fail?
Yes
Replace the cold junction compensating sensor.
No
● Temporarily operate the converter by turning its power switch.
Is the error displayed?
Yes
The electronic circuit in the converter may possibly be failed. Contact Yokogawa.
No
End. Set the temporary data.
● Examine fuses (F1 and F2) for the detector heater whether or not they are blown and then check wiring connections to the converter terminals 5, 6, 7, 8, 16, and 17. If the repeater terminal box is used, also check the connections inside the box.
● Examine wiring connections to the detector terminals 3, 4, 5, 6, 7, and 8. Check if the terminal and cable conductors are not corroded. Also check that wiring is not shortcircuited between the converter and the detector.
● Remove wiring to the converter terminals 16 and 17 and measure resistance between these leadwires. If it is 90 Ω or lower, it is normal. In addition, lead resistances between the converter and detector are normal if they are 10 Ω or less.
● Remove wiring to the converter terminals 5 and 6 and measure resistance between these leadwires. If it is 15 Ω or lower, it is normal. In addition, lead resistances between the converter and detector are normal if they are 10 Ω or less.
● Examine that the cold junction compensating sensor leadwires connected to wiring terminals 7 and 8 in the detector are not disconnected. If the cold junction compensating sensor is normal, the voltage across terminals 7 and 8 is about 0.4 to 0.7 V (varies with ambient temperatures).

F10.2E.ai

10.1.4 Causes of "E--3 Sensor Temperature Error (High)" and Procedure for Restoration

This error occurs when the converter detects that the sensor temperature is higher than 780°C. It also occurs if the converter detects failure of the heater circuit and temperature measuring and controlling circuit during warm-up.

< Causes >

If the error code is displayed in steady state operation, the following is considered as the causes.

(1) Cold junction compensating sensor failure at the detector terminal board.

(2) Failure of thermocouple in the detector

(3) Failure of electronic circuits in the converter.

Next, if the error code is displayed during warm-up, the following is considered as the causes.

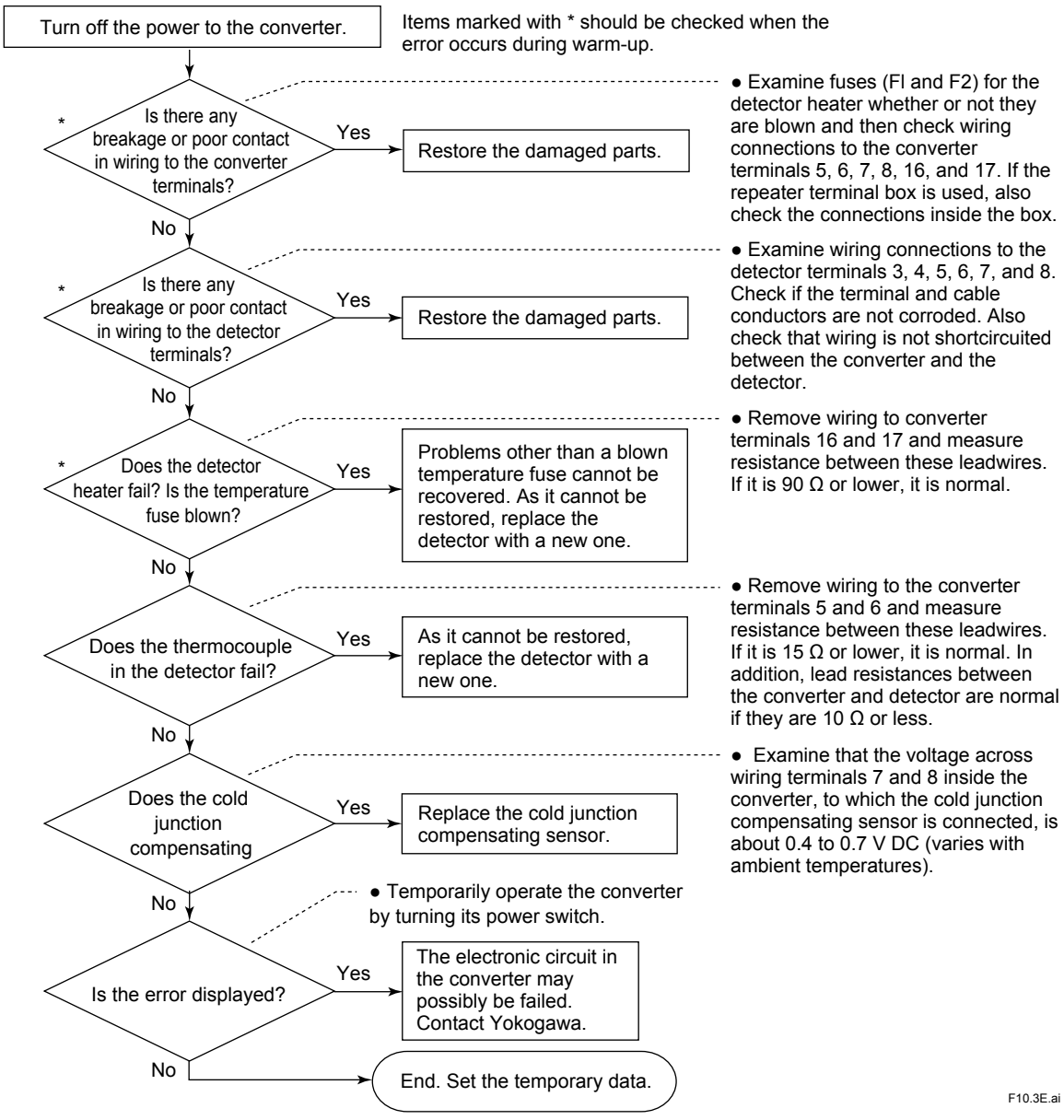
(1) Fuses (F1 and/or F2) in the converter for the detector heater are blown.

(2) Wiring failure between the converter and the detector (poor contact at the terminal connections, disconnection, shortcircuiting, etc.)

(3) Failure of the heater in the detector (disconnection, etc.)

(4) Blown heater temperature fuse in the detector

< Locating the Failure and Taking Measures >


Turn off the power to the converter.
Items marked with * should be checked when the error occurs during warm-up.
* Is there any breakage or poor contact in wiring to the converter terminals?
Yes
Restore the damaged parts.
● Examine fuses (Fl and F2) for the detector heater whether or not they are blown and then check wiring connections to the converter terminals 5, 6, 7, 8, 16, and 17. If the repeater terminal box is used, also check the connections inside the box.
No
* Is there any breakage or poor contact in wiring to the detector terminals?
Yes
Restore the damaged parts.
● Examine wiring connections to the detector terminals 3, 4, 5, 6, 7, and 8. Check if the terminal and cable conductors are not corroded. Also check that wiring is not shortcircuited between the converter and the detector.
No
* Does the detector heater fail? Is the temperature fuse blown?
Yes
Problems other than a blown temperature fuse cannot be recovered. As it cannot be restored, replace the detector with a new one.
● Remove wiring to converter terminals 16 and 17 and measure resistance between these leadwires. If it is 90 Ω or lower, it is normal.
No
Does the thermocouple in the detector fail?
Yes
As it cannot be restored, replace the detector with a new one.
● Remove wiring to the converter terminals 5 and 6 and measure resistance between these leadwires. If it is 15 Ω or lower, it is normal. In addition, lead resistances between the converter and detector are normal if they are 10 Ω or less.
No
Does the cold junction compensating
Yes
Replace the cold junction compensating sensor.
● Examine that the voltage across wiring terminals 7 and 8 inside the converter, to which the cold junction compensating sensor is connected, is about 0.4 to 0.7 V DC (varies with ambient temperatures).
No
● Temporarily operate the converter by turning its power switch.
Is the error displayed?
Yes
The electronic circuit in the converter may possibly be failed. Contact Yokogawa.
No
End. Set the temporary data.

F10.3E.ai

10.1.5 Causes of "E--4 A/D (Analog Circuit) Failure" and Procedure for Restoration

This error occurs when the electric circuit of the converter does not operate normally.

< Causes >

(1) The analog circuits of the converter contains a failure.

(2) The supply voltage significantly drops (15% or more of the rating).

< Locating the Failures and Measures >

Turn the power to the converter off and then back on. Then check whether or not the operation is normal.

If the operation is normal, it is considered that the error may be caused by temporary failure of power system, such as voltage drop or influence of noise. If the cause is clear and the error may possibly occur with the same cause, take suitable measures to prevent re-occurrence.

If the error occurs again, it may be caused with the converter electric circuits, such as CPU card. In this case, it is not so easy to find the failed part and to restore. If the error occurs again, contact Yokogawa. Confirm that power system is not in failure by checking the supply voltage and others to make sure of it.

10.1.6 Causes of "E--5 Calibration Value Error (Zero)" and Procedure for Restoration

This error occurs when the zero point correction factor (see Subsection 8.1.3) exceeds the range 100 ± 30% in the automatic and semi-automatic calibrations.

< Causes >

(1) The oxygen concentration of zero gas and the value set with function No. C-1 do not agree or the span gas is accidentally used as the zero gas.

(2) The zero gas does not flow by the specified quantity (about 600 ml/min).

(3) The sensor (cell) is damaged and the cell emf contains an error.

< Locating the Cause of Failure and Taking Measures >

(1) To make sure, carry out the calibration once more. Before calibration, examine the following. If they are not in normal state, correct them.

- Does the value set in the function No. C-1 agree with the zero gas oxygen concentration?
- Does the calibration gas tubing have measures to no zero gas leakage?

(2) If the error does not occur in re-calibration, it is considered as the cause of the error in the first calibration that the calibrating conditions were not proper. In this case, no particular restoration is necessary. Restart the steady state operation.
If the error also occur in re-calibration, it is considered as the cause of error occurrence that the sensor deteriorates or is damaged. Confirm that the error corresponds to one or more of the following phenomena and replace it with a new sensor (see 10.1.4).

- When zero gas is passed, the sensor (cell) emf indicated with function No. A-3 greatly differs from the theoretical value in that oxygen concentration.
- When three kinds of gas (zero gas, span gas, and the gas having approximately middle oxygen concentration between the above two) are measured, correlation cannot be found in these measured data for oxygen concentration.
  In addition, check the sensor deterioration or damage which caused the error occurrence whether or not it abruptly occurs by the following phenomena. If abrupt occurrence may be suspected, check the check valve located at the inlet of detector calibration gases whether or not the valve has failed. Check valve failure causes condensed water in the calibration gas tubing, which is the cause of sensor breakage.
- Examine historical data of the zero point correction factor displayed with function No. B-1. Permissible range of the zero point correction factor is 100 ± 30%.
- Examine the sensor (cell) internal resistance displayed with function No. B-3. A new sensor shows the value of 200 Ω or less. While the dissipated sensor approaching to the end of the life indicates the value of 3 to 10 kΩ.
- Examine the sensor integrity data (five grade evaluation of 5 to 1) displayed with function No. B-4. A sensor in good state shows "5".

10.1.7 Causes of "E--6 Calibration Value Error (Span)" and Procedure for Restoration

This error occurs when the span point correction factor (see Subsection 8.1.3) exceeds the range 0 ± 18% in the automatic and semi-automatic calibrations.

< Causes >

(1) The oxygen concentration of span gas and the value set with function No. C-0 do not agree or the zero gas is accidentally used as the span gas.

(2) The span gas does not flow by the specified quantity (600 ± 60 ml/min).

(3) The sensor (cell) is damaged and the cell emf contains an error.

< Locating the Cause of Failure and Taking Measures >

(1) To make sure, carry out the calibration once more. Before calibration, examine the following. If they are not in normal state, correct them.

- Does the value set in the function No. C-0 agree with the span gas oxygen concentration?
- Does the calibration gas tubing have measures to no span gas leakage?

(2) If the error does not occur in re-calibration, it is considered as the cause of the error in the first calibration that the calibrating conditions were not proper. In this case, no particular restoration is necessary. Restart the steady state operation.
If the error also occur in re-calibration, it is considered as the cause of error occurrence that the sensor deteriorates or is damaged. Confirm that the error corresponds to one or more of the following phenomena and replace it with a new sensor (see Section 10.1.4).

- When span gas is passed, the sensor (cell) emf indicated with function No. A-3 greatly differs from the theoretical value in that oxygen concentration.
- When three kinds of gas (zero gas, span gas, and the gas having approximately middle oxygen concentration between the above two) are measured, correlation cannot be found in these measured data for oxygen concentration.

In addition, check the sensor deterioration or damage which caused the error occurrence whether or not it abruptly occurs by the following phenomena. If abrupt occurrence may be suspected, check the check valve located at the inlet of detector calibration gases whether or not the valve has failed. Check valve failure causes condensed water in the calibration gas tubing, which is the cause of sensor breakage.

- Examine historical data of the span point correction factor displayed with function No. B-0. Permissible range of the span point correction factor is 0 ± 18%.
- Examine the sensor (cell) internal resistance displayed with function No. B-3. A new sensor shows the value of 200 Ω or less.
  While the dissipated sensor approaching to the end of the life indicates the value of 3 to 10 kΩ.
- Examine the sensor integrity data (five grade evaluation of 5 to 1) displayed with function No. B-4. A sensor in good state shows "5".

10.1.8 Causes of "E--7 EMF Stabilization Time Over" and Procedure for Restoration

This error occurs when the sensor (cell) emf is not stabilized even if the calibration time is over because the sensor part of the detector is not filled with calibration gas (zero and span gases) at the one -touch calibration.

< Causes >

(1) Flow of the calibration gas is small (specified flow : 600 ± 60 ml/min).

(2) Measuring gas flows toward the tip of the detector probe.

(3) Sensor (cell) response is deteriorated.

< Locating the Cause of Failure and Taking Measures >

(1) Examine the setting time with function No. C-4 whether or not it is suitable. If not suitable, modify the setpoint and perform recalibration again. Carry out recalibration after confirming that the tubings does not leak and flowing calibration gas by the specified rate (about 600 ml/min).

(2) When calibration is normally carried out, continue the steady state operation.
If the error occurs again, replace the sensor assembly after checking that whether or not the error corresponds to the following.

- Dust significantly sticks to the detector probe tip. — If dust sticks, clean it (see 9.1.5, 9.1.6).
  If the error occurs in calibration even after the sensor assembly is replaced, influence of measuring gas flow is considered as the cause. Make the measuring gas not flow toward the detector probe tip by changing the mounting position of the detector or in other means.

10.1.9 Causes of “E--8 ROM and RAM Failure” and Procedure for Restoration

This error occurs when ROM contents reading and/or writing memory to RAM are not possible.

< Causes >

(1) ROM and RAM pins are not fully inserted into the socket.

(2) High supply voltages exceeding the specifications are applied or the effect of noise is given to ROM and RAM.

(3) ROM and/or RAM failed.

(4) Failure occurred in digital circuits on the CPU board and others.

< Locating the Cause of Failure and Taking Measures >

Turn off the power to the converter. Check that the supply voltage is the rated voltage. Then turn on the power. Check that the converter is operating normally.

If the error also occurs, repair is necessary. Contact Yokogawa.

10.1.10 Causes of Display Disappearance (Data Display) and Procedure for Restoration

Operation of the converter digital circuits is being self-checked with the watchdog timer (WDT) or clock monitor.

This error occurs when power is turned on again after power supply to the converter electrical circuit is interrupted due to power failure. This error also occurs when the converter digital circuits fail, such as time-up of the watchdog timer normally reset in a fixed period. In either case, if the error occurs, display in the data display disappears.

Next, measures when the error occurs due to the digital circuit operation failure will be described.

< Causes >

(1) Low supply voltages exceeding the specifications are applied or the effect of noise is given to digital circuits.

(2) Digital circuit failure.

< Locating the Cause of Failure and Taking Measures >

Turn off the power to the converter. Check for a blown fuse in the electric circuitry. Also check that the supply voltage is the rated voltage. Then turn on the power. Check that the converter is operating normally.

If the error occurs again, repair is necessary. Contact Yokogawa.

10.2 Where the Output Response Is Too Slow

If the suction flowrate of a sample gas decreases, check to see that the detector's main ejector is not clogged. When the probe adaptor is used, also check that the auxiliary ejector is not clogged.

10.2.1 Checking the Main Ejector for Clogging

(1) Remove the main ejector from the detector.

(2) Remove the ejector nozzle from the air supply side. (There is a threaded M5-size opening for withdrawing the nozzle. So, use an appropriate screw to remove the nozzle.)

(3) After removing the nozzle, check that the ejector outlet hole (defuser) or gas suction portion is not clogged. If clogging is found, clean it or that portion to remove the blockage. Reverse the procedure for replacement.

10.2.2 Checking the Auxiliary Ejector for Clogging

(1) Remove the auxiliary ejector from the probe adaptor.

(2) Remove the nozzle from the air supply side. (For the nozzle replacement, be sure to install the nozzle correctly.)

(3) After removing the nozzle, check that the ejector (T-shaped joint) is not clogged. If clogging is found, clean it to remove clogged areas. Reverse the procedure for replacement.

10.2.3 Checking the Tip Filter (SiC) for Clogging

If the ejector is not clogged, check the probe's tip filter for clogging. If clogging is found, clean or replace it. For filter replacement, see the applicable instruction manuals (see Section 9.1.5 in this manual).

10.2.4 Others

If there is no clogging in the ejector or SiC filter, the sensor may be defective, or the flame arrester may be clogged. Check the flame arrester or replace the cell.

10.3 Measures When Measured Value Shows an Error

The causes that the measured value shows an abnormal value is not always due to instrument failures. There are rather many cases where the causes are those that measuring gas itself is in abnormal state or external causes exist, which disturb the instrument operation. In this section, causes of and measures against the cases where measured values show the following phenomena.

(1) The measured value is higher than the true value.

(2) The measured value is lower than the true value.

(3) The measured value sometimes show abnormal values.

10.3.1 Measured Value Higher Than True Value

< Causes and Measures >

If the converter's indicated value is higher than the true value, the following probable causes may be found. Check the following:

(1) The ejector pressure is set improperly.
If the ejector pressure is set as indicated below, the converter's indicated value is higher than the true value, or the air concentration is indicated.

1. For general-use converters
   Even though the furnace's internal pressure is negative, a higher ejector suction pressure (on the positive side) than that pressure is set.
2. For high-temperature detectors with probe adaptors
   Even though the furnace internal pressure is negative, the suction pressure of the probe adaptor-side ejector (hereinafter referred to as auxiliary ejector) is higher than that pressure which is set. Or a higher suction pressure of the detector-side ejector (hereinafter referred to as a main ejector) than the furnace internal pressure is set.
   See Section 6.1.8 for ejector supply pressure setting.

(2) If there is a pressure leak in the detector or probe adaptor flange.
The following probable causes may be found:

1. The calibration gas inlet pipings or joint sections are leaky.
2. The flange joint sections are leaky.

(3) The measuring gas pressure becomes higher.
The measured oxygen concentration value X (vol% O_2) is expressed as shown below, when the measuring gas pressure is higher than that in calibration by Δp (mm H_2O).

$$X = Y\,[\,1 + (\Delta p/10336)\,]$$

where Y: Measured oxygen concentration value at the same pressure as in calibration (vol% O_2).

Where an increment of the measured value by pressure change cannot be neglected, measures must be taken.

Investigate the following points to perform improvement available in each process.

- Is improvement in facility's aspect available so that pressure change does not occur?
- Is performing calibration available under the averaging measuring gas pressure (internal pressure of a furnace)?

(4) Moisture content in a reference gas changes (increase) greatly.
If air at the detector installation site is used for the reference gas, large change of moisture in the air may cause an error in measured oxygen concentration value (vol% O_2).
When this error is not ignored, use a gas in which moisture content is constant such as instrument air in almost dry condition as a reference gas.
In addition, change of moisture content in exhaust gas after combustion is also considered as a cause of error. However, normally this error is negligible.

(5) Calibration gas (span gas) is mixing into the detector due to leakage.
If the span gas is mixing into the detector due to leakage for the reason of failure of the valve provided in the calibration gas tubing system, the measured value shows a value a little higher than normal.
Check valves in the calibration gas tubing system for leakage. For manual valves, check them after confirming that they are in fully closed state.

(6) The reference gas is mixing into the measuring gas and vice versa.
Since the difference between oxygen partial pressures on the sensor anode and cathode sides becomes smaller, the measured value shows a higher value.
An error which does not appear as the error “E--1” may occur in the sensor. Visually inspect the sensor. If any crack is recognized, replace it with a new sensor assembly.

(Note) Data such as cell integrity displayed with function No. B-4 should also be used for deciding sensor quality.

10.3.2 Measured Value Lower Than True Value

< Causes and Measures >

(1) The measuring gas pressure becomes lower.
Where an increment of the measured value by pressure change cannot be neglected, take measures referring to Subsection 9.1.1 (1).

(2) Moisture content in a reference gas changes (decrease) greatly.
If air at the detector installation site is used for the reference gas, large change of moisture in the air may cause an error in measured oxygen concentration value (vol% O_2).
When this error is not ignored, use a gas in which moisture content is constant such as instrument air in almost dry condition as a reference gas.
In addition, change of moisture content in exhaust gas after combustion is also considered as a cause of error. However, normally this error is negligible.

(3) Calibration gas (zero gas) is mixed into the detector due to leakage.
If the zero gas is mixed into the detector due to leakage for the reason of failure of the valve provided in the calibration gas tubing system, the measured value shows a value a little lower than normal.
Check valves in the calibration gas tubing system for leakage. For manual valves, check them after confirming that they are in fully closed state.

10.3.3 Measured Value Sometimes Show Abnormal Values

< Causes and Measures >

(1) Noise is mixed into the converter from the detector output wiring.

Take measures so that noise is not mixed into the converter, e.g., by shielding the wiring.

(2) The converter is affected with noises from the power supply.

Insert the line filter in the power line.

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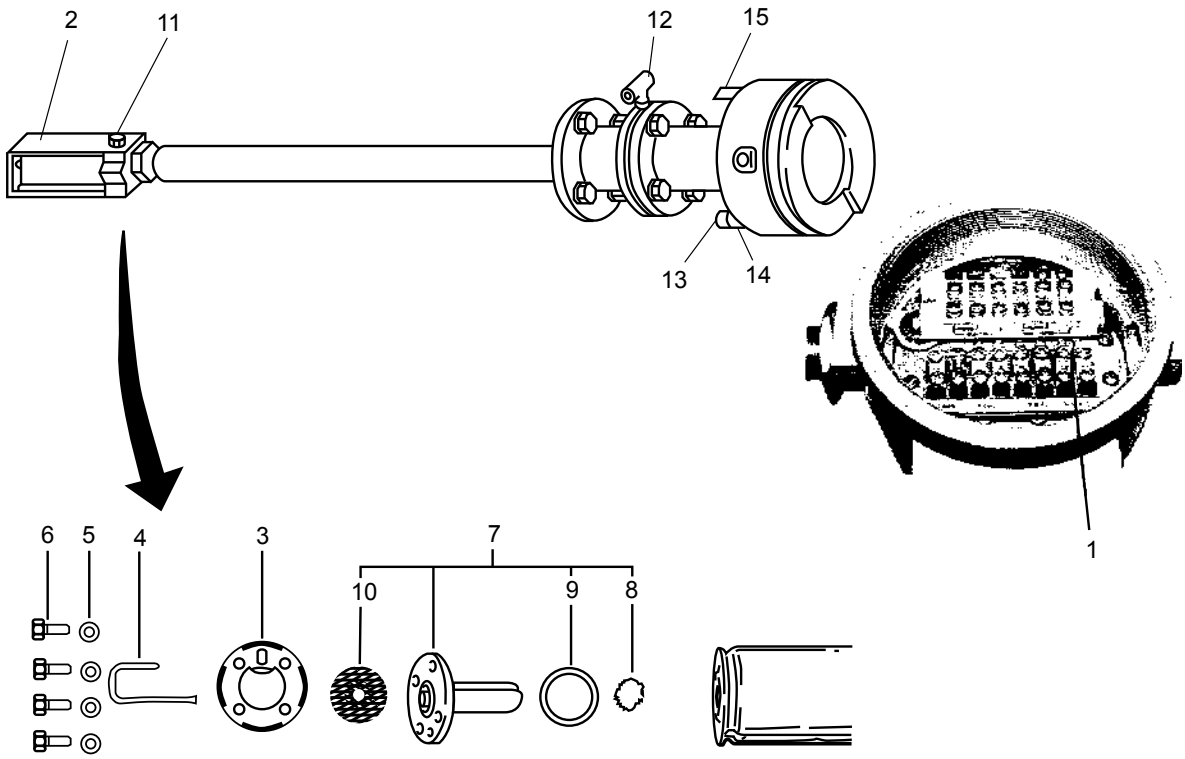
Customer Maintenance Parts List

ZS8D
Flameproof
Zirconia Oxygen Analyzer
Detecter (Standard type)

EXA OXY



Item	Parts No.	Qty	Description
1	K9292CX	1	Cold Junction Assembly
2	K9292DE	1	Filter Assembly
3	E7042BR	1	Plate
4	E7042BQ	1	Pipe
5	E7042DW	4	Washer (M5, SUS304 stainless steel)
6	G7109YC	4	Bolt (M5x12, SUS316, stainless steel)
7	E7042UD	1	Cell Assembly (with Japanese introduction sheet)
8	E7042BS	1	Contact
9	K9470BJ	1	Metal O-Ring
10	E7042AY	1	Filter Assembly
11	Y9508RU	2	Bolt
12	K9292VA	1	Ejector Rc1/4
	K9292VB	1	Ejector 1/4NPT
13	K9292DN	1	Check Valve Rc1/4
	K9292DS	1	Check Velve 1/4NPT
14	K9292BA	1	Flame Arrestor Calibration gas. Reference air Inlet. Rc1/4
	K9292BB	1	Flame Arrestor Calibration gas. Reference air Inlet. 1/4NPT
15	K9292BU	1	Flame Arrestor Reference air outlet Rc1/4
	K9292BY	1	Flame Arrestor Reference air outlet 1/4NPT

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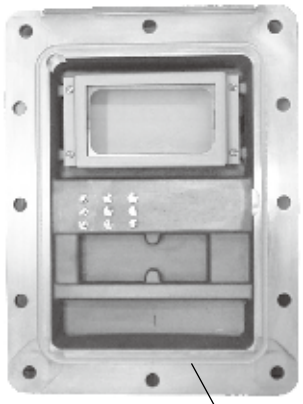
Customer Maintenance Parts List

ZS8C
Flameproof
Zirconia Oxygen Analyzer
Converter

EXA OXY



Item	Parts No.	Qty	Description
1	K9291XA	1	Packing
2	Y9635ZU	12	Bolt M12x35 SUS

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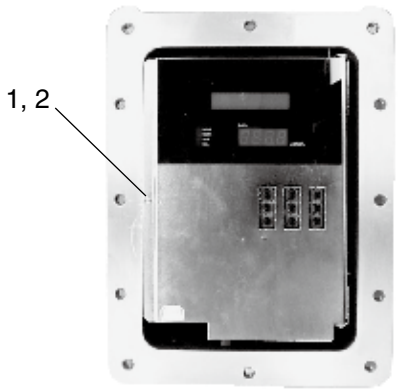
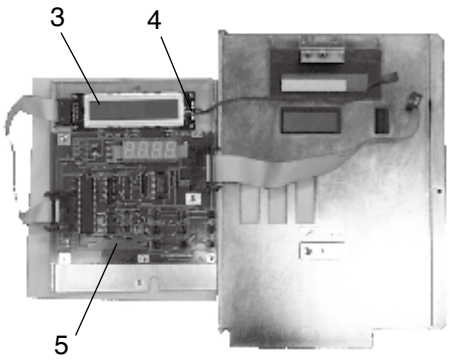
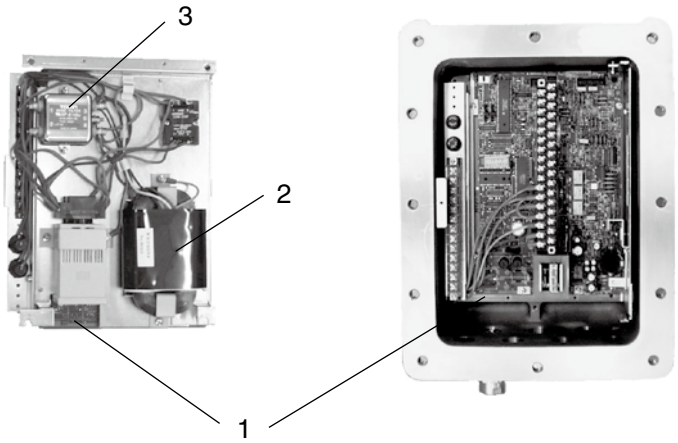


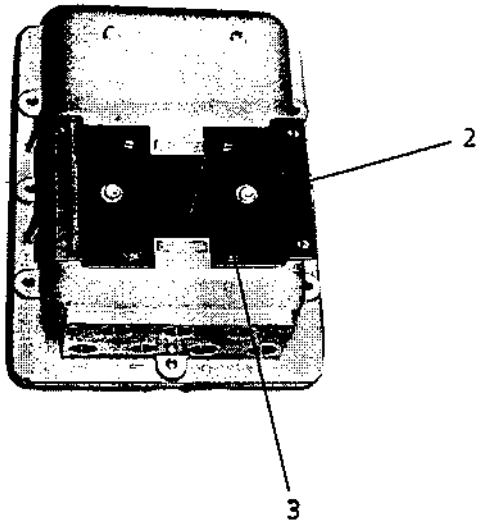


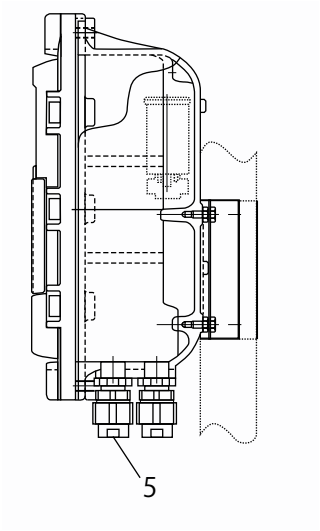
Item	Parts No.	Qty	Description
1	Y9406LS	1	Screw
2	L9801BF	1	Washer
3	K9291DP	1	LCD Assembly
4	L9813VJ	4	Clamp
5	K9291PA	1	Display Assembly

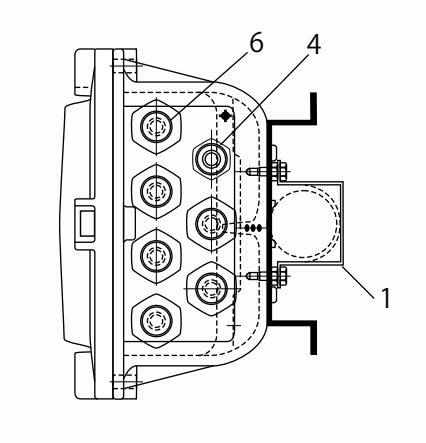


Item	Parts No.	Qty	Description
1	K9291QA	1	CPU Assembly (for ZS8C-J-5-□-J/□/□)
	K9291QF	1	CPU Assembly (for ZS8C-J-8-□-J/□/□)
	K9291QL	1	CPU Assembly (for ZS8C-J-3(or 4)-□-J/□/□)
	K9291QB	1	CPU Assembly (for ZS8C-J-5-□-E/□/□)
	K9291QG	1	CPU Assembly (for ZS8C-J-8-□-E/□/□)
	K9291QM	1	CPU Assembly (for ZS8C-J-3(or 4)-□-E/□/□)
2	K9291YA	1	Controller (ZS8C-J-□-1-□/□/□ only)
3	K9291YD	1	Noise Filter (ZS8C-J-3(or 4)-□-□/□/□ only)

4







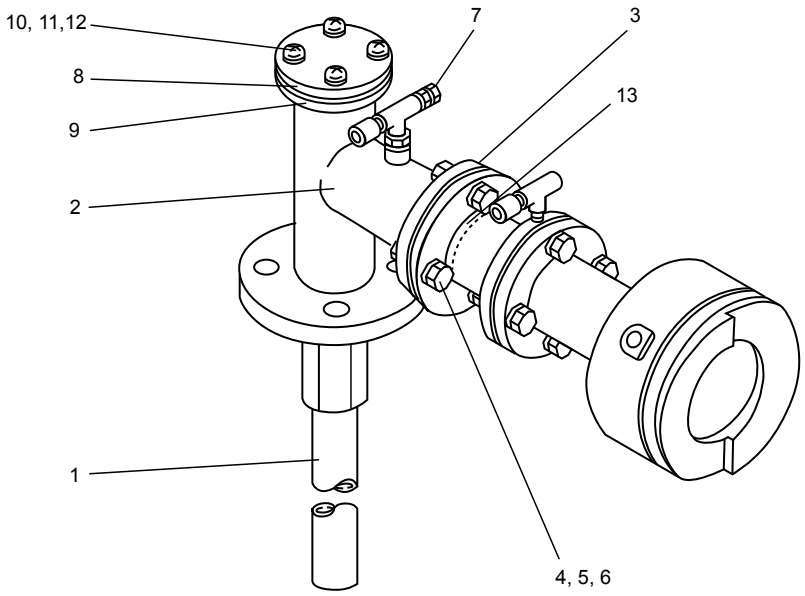
Item	Parts No.	Qty	Description
1	K9291FB	1	Bracket (pipe mounting only)
2	K9291FA	1	Bracket (wall mounting only)
3	Y9814NU	4	Screw
4	K9291FE	1	Flame Arrestor Assembly Rc1/4
	K9291FF	1	Flame Arrestor Assembly 1/4NPT
5	G9601AE	4	Cable Gland Assembly
6	G9330DQ	3	Plug

Customer Maintenance Parts List

ZS8P-H
Flameproof
Zirconia Oxygen Analyzer
Probe Adaptor

EXA OXY

Style:S2



Item	Parts No.	Qty	Description
1	K9292TP	1	Probe (SiC, L=0.5m)
	K9292TQ	1	Probe (SiC, L=0.7m)
	E7046AL	1	Probe (SiC, L=1.0m)
	E7046BB	1	Probe (SiC, L=1.5m)
	K9292TV	1	Probe (SUS 310S, L=0.5m)
	K9292TW	1	Probe (SUS 310S, L=0.7m)
	E7046AP	1	Probe (SUS 310S, L=1.0m)
	E7046AQ	1	Probe (SUS 310S, L=1.5m)
2	K9292TA	1	Case (for JIS 10K-100-FF equivalent)
	K9292TB	1	Case (for ANSI CLASS150-4-RF equivalent)
	K9292TC	1	Case (for DIN PN10-DN100-A equivalent)
	K9292TD	1	Case (for JPI CLASS150-4-RF equivalent)
3	K9292UJ	1	Gasket
4	Y9660RU	4	Bolt
5	Y9121BU	4	Nut
6	Y9120WU	8	Washer
7	K9292WA	1	Sub Ejector (Rc1/4)
	K9292WB	1	Sub Ejector (1/4NPT)
8	E7046FQ	1	Gasket
9	E7046FN	1	Plate
10	Y9825NU	4	Screw
11	Y9800WU	8	Washer
12	Y9801BU	4	Nut
13	K9292DL	1	Gasket

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4th Edition : Oct. 2010 (YK)

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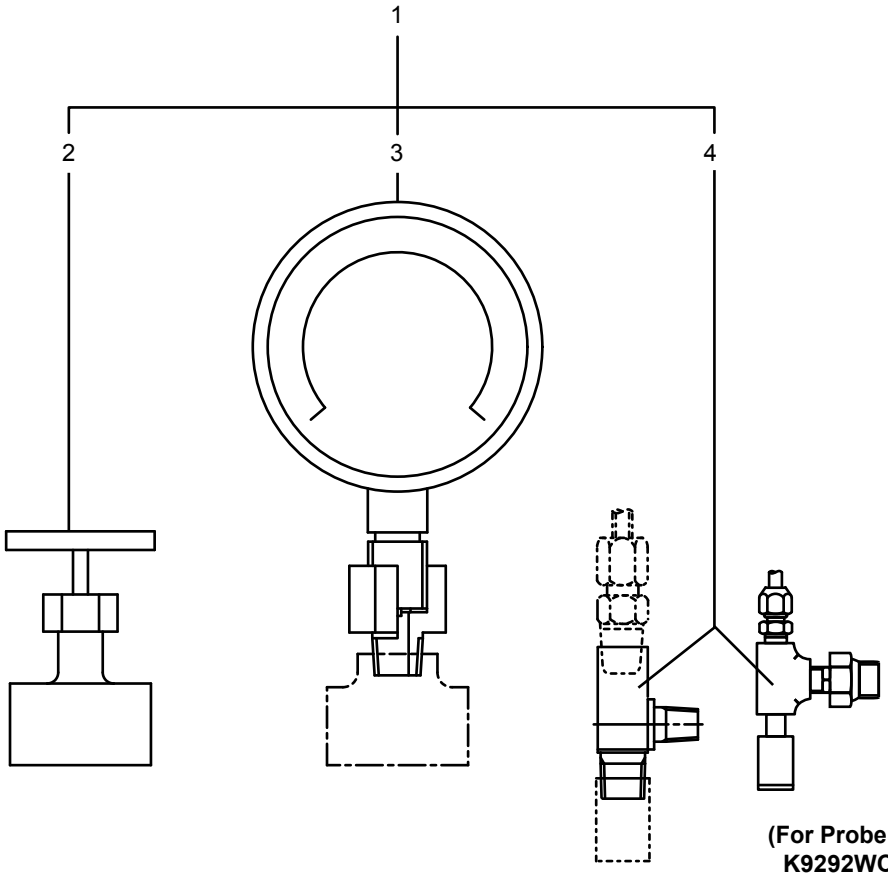
Customer Maintenance Parts List

Flameproof
Zirconia Oxygen Analyzer
Auxiliary Ejector
K9292VA, K9292VB, K9292WA, K9292WB

EXA OXY



(For Probe Adaptor Use)
K9292WC / K9292WD

(For Detector Use)
K9292VE / K9292VF

Item	Parts No.	Qty	Description
1	K9292VA	1	Main Ejector, Connection Rc1/4 For Detector Use
	K9292VB	1	Main Ejector, Connection 1/4NPT For Detector Use
	K9292WA	1	Auxilliary Ejector, Connection Rc1/4 For Probe Adaptor Use
	K9292WB	1	Auxilliary Ejector, Connection 1/4NPT For Probe Adaptor Use
2	L9852CB	1	Needle Valve, Connection Rc1/4
	G7016XH	1	Needle Valve, Connection 1/4NPT
3	E7046EK	1	Pressure Gauge, Connection Rc1/4
	E7046EV	1	Pressure Gauge, Connection 1/4NPT
4	K9292VE	1	Ejector Assembly, Connection Rc1/4 For Detector Use
	K9292VF	1	Ejector Assembly, Connection 1/4NPT For Detector Use
	K9292WC	1	Ejector Assembly, Connection Rc1/4 For Probe Adaptor Use
	K9292WD	1	Ejector Assembly, Connection 1/4NPT For Probe Adaptor Use

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CMPL 11M7A3-11E
2nd Edition : Apr. 2001 (YK)

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Revision Record

- Manual Title : EXA OXY Direct In-Situ Flameproof Zirconia Oxygen Analyzer
- Manual Number : IM 11M7A3-01E

Edition	Date	Remark (s)
1st	Apr. 1996	Newly published
2nd	Mar. 1997	Some error corrected
3rd	Sep. 2010	IM style & Format renewed Revised and Corected all over (“After-Sales Warranty” added, etc.)
4th	Jul.2011	Revised of wiring for explosionproof and parts.

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User's Manual

Model ZS8 Flameproof Zirconia Oxygen Analyzer

Supplement

Thank you for selecting our Model ZS8 Flameproof Zirconia Oxygen Analyzer.
User's Manual, IM 11M7A3-01E, 4th Edition, supplied with the product, some revisions/additions have been made. Please replace the corresponding pages in your copy with the attached, revised pages.

Revisions:

- Page 3-4, Section 3.6, "Purge Gas Piping": Deleted the description partly.
- Page 4-11, Section 4.5.2, "Ground Wiring" : Changed of the "Figure 4.11 Wiring Diagram".
- Page 9-7, Section 9.2.1, "Replacing Fuses" Figure9.3: Changed the part number of fuse.
  "<Main fuse>" (3): Changed of the description.

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IM 11M7A3-01E
4th Edition

3.6 Purge Gas Piping

If there are corrosive gases in the atmosphere, or if the ambient temperature at the converter-installed location is high, purge the inside of the converter with air. Connect a copper or stainless steel pipe to the purge air inlet. Set the supply air to about 50 kPa.

Unit: mm

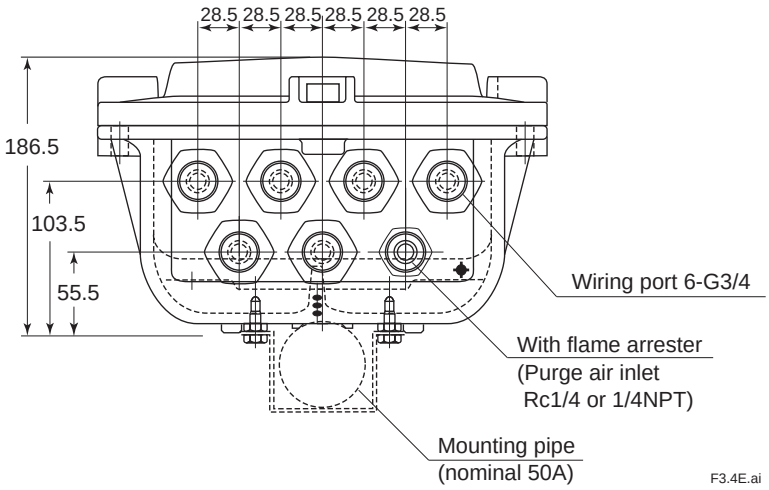


Figure 3.4 Converter Purging

3.6.1 Piping for Air Purge in Converter

If specified, the air purge joint is already connected to the bottom of the converter upon shipment. Make piping using a copper tube or the like with an OD of 6 mm / ID of 4 mm (or nominal size 1/4-inch) between the air supply and the air purge joint.

3.6.2 Air Supply for Air Purging

Implement air purging using clean dry air. For example, use instrument air as the air supply. Air consumption is about 1 l/min when the supply air pressure is 50 kPa.

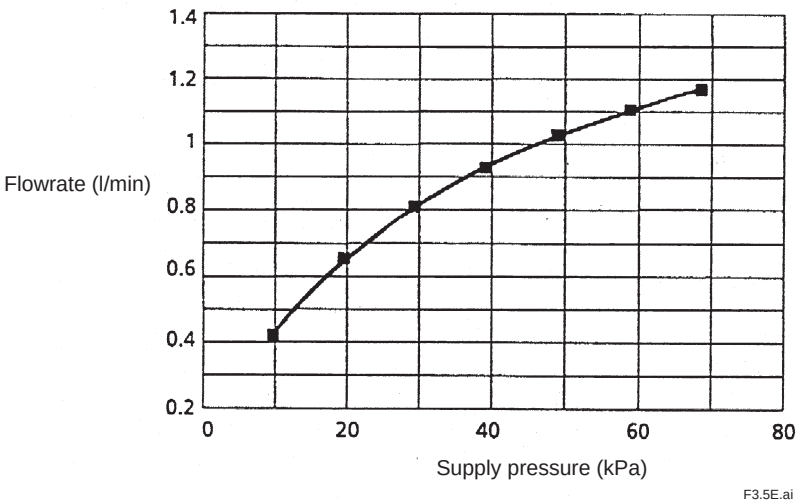
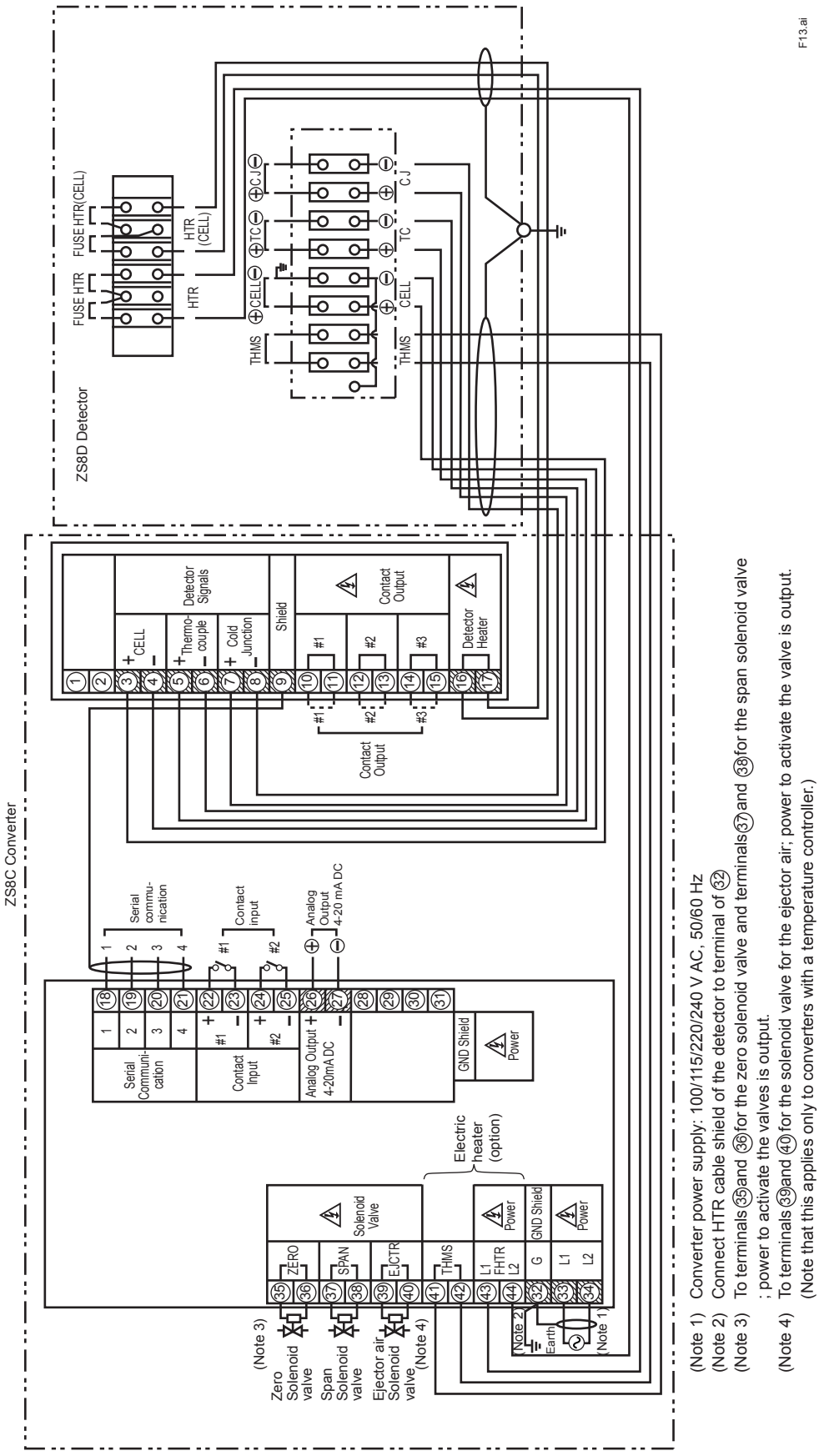


Figure 3.5 Flow Characteristics of Joint on Air Supply Side



(Note 1) Converter power supply: 100/115/220/240 V AC, 50/60 Hz
(Note 2) Connect HTR cable shield of the detector to terminal of ㉜.
(Note 3) To terminals ㉟ and ㊱ for the zero solenoid valve and terminals ㊲ and ㊳ for the span solenoid valve ; power to activate the valves is output.
(Note 4) To terminals ㊴ and ㊵ for the solenoid valve for the ejector air; power to activate the valve is output.
(Note that this applies only to converters with a temperature controller.)

Figure 4.11 Wiring Diagram

9.2 Inspection and Maintenance of the Converter

You need not inspect or perform maintenance work on the converter daily or periodically. If the converter fails to work properly, it might come from power failure or other causes in most cases. However, burned out fuses or ambiguous readouts on the message display after long-time use are sometimes caused by deterioration of the related parts.

9.2.1 Replacing Fuses

The converter incorporates a total of 6 fuses: 2 for the detector heater and 2 for the electric circuit in the converter except 2 main fuses for whole protection. If any fuse burns out, replace it in the following manner. However, it is recommended that the fuses for the detector heater (F1, F2) be replaced every 2 years even if they are not burned out.

(Note) If a replaced fuse blows out immediately, a problem may exist in the circuit. Completely go over the circuit to find out why the fuse blew.

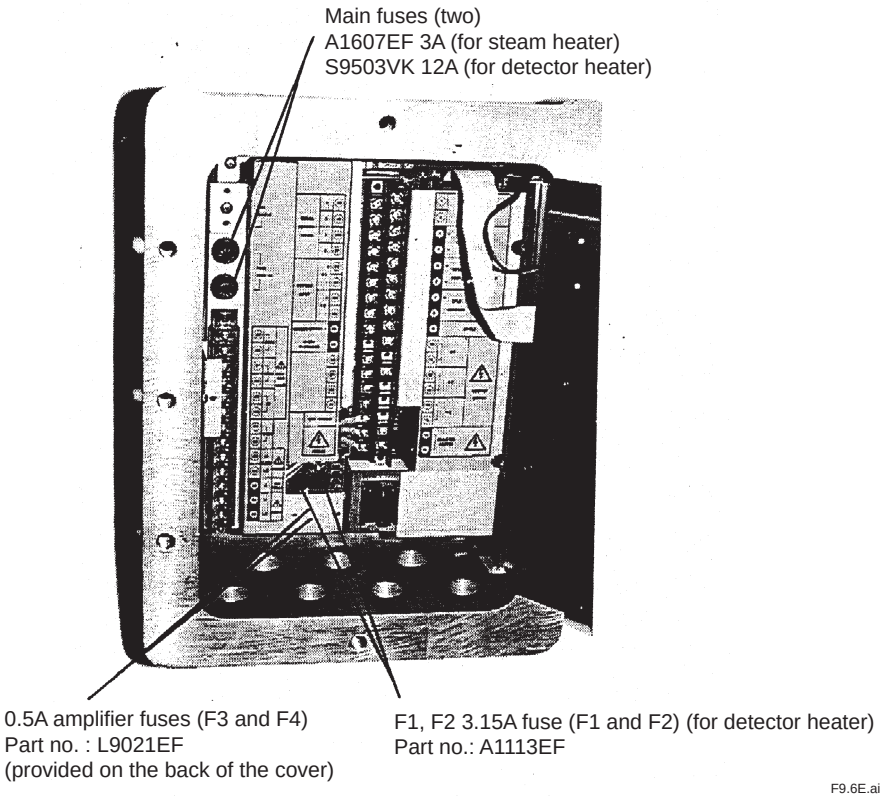

Main fuses (two)
A1607EF 3A (for steam heater)
S9503VK 12A (for detector heater)
0.5A amplifier fuses (F3 and F4)
Part no. : L9021EF
(provided on the back of the cover)
F1, F2 3.15A fuse (F1 and F2) (for detector heater)
Part no.: A1113EF
F9.6E.ai

Figure 9.3 Locations of Fuses for Converter

<Main fuse>

(1) Before replacing the fuse, turn off the converter's power supply.

(2) Loosen the fuse from its holder by turning the holder cap counterclockwise. Then remove the fuse with its cap from the holder.

(3) Be sure that the new fuse is rated at steam heater 3A and detector heater 12A. Insert it into the fuse cap and then place it in the fuse holder. To complete the replacement, turn the cap clockwise until it stops.